PLAN for

WATERSHED PROTECTION

FLOOD PREVENTION

and

RECREATION

# WET WALNUT CREEK SUBWATERSHED NO. 1

BARTON and RUSH COUNTIES, KANSAS

# ADDENDUM

## WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

This addendum was developed in accordance with phase-in procedures adopted by the Water Resources Council for level C plans for which field studies, analyses, and evaluations were completed as of October 25, 1973, and which have been formulated in accordance with Senate Document 97, as supplemented and amended. This plan was developed using 1974 prices and a 6 1/8 percent discount rate.

Section I of this addendum shows the benefit-cost ratio with and without secondary benefits using the price base and discount rate used in the plan.

Section II of this addendum displays an abbreviated alternative plan for Wet Walnut Creek Basin as a whole and was developed to emphasize environmental quality. This is a hypothetical plan, not to be installed, which presents information for comparison with the selected plan.

Section III of this addendum displays the effects of the selected plan for Wet Walnut Creek as evaluated for each of the separate accounts--national economic development, environmental quality, regional development, and social well-being.

# SECTION I

of

# ADDENDUM

for

# WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

This section shows the project costs, benefits, and benefit-cost ratio based on 6 1/8 percent interest rate.

| | | |
|---|---|---|
| 1. | Average annual project costs are | $153,000 |
| 2. | Average annual project benefits without secondary benefits are | $208,400 |
| 3. | Average annual project benefits with secondary benefits are | $238,700 |
| 4. | The project benefit-cost ratio without secondary benefits is | 1.4 to 1.0 |
| 5. | The project benefit-cost ratio with secondary benefits is | 1.6 to 1.0 |

December 1975

SECTION II

of

ADDENDUM

for

WET WALNUT CREEK WATERSHED, KANSAS

Abbreviated Environmental Quality Plan

This Environmental Quality Plan must consider the Wet Walnut Creek basin as a whole. This plan is not restricted by limitations of any existing authority such as PL-566. Elements to be installed in certain portions of the basin are interrelated to elements and effects in other portions of the basin therefore necessitating basin-wide planning.

Environmental Problems

A. Natural Beauty and Human Enjoyment Area Problems

Shade tree population and quality in small towns within the basin have deteriorated in recent years due to Dutch Elm disease and improper management.

Open spaces for public use within the basin are non-existent. Recreational facilities within reasonable distance from the area are limited.

B. Biological Resource Problems

The existence and needs of rare and endangered species within the basin is little known.

Educational facilities focusing on the environment and preservation of natural resources are lacking in the basin.

The lack of diversity in large tract farming practices has adversely affected wildlife species.

Many acres of Type 1 and 2 wetlands in the western part of the basin are not utilized to their fullest potential for enhancement of wildlife.

The lack of ground water management within the basin has adversely affected stream aquatic habitat and riparian habitat.

C. Archeological and Historical Sites Problems

Archeological, historical, and unique architectural sites are unrecorded or destroyed because of the lack of information and communication between the local public and interested authorities.

D. Land, Water and Air Quality Problems

Unprotected sloping cropland and rangeland within the basin are subject to moderate or severe sheet erosion. The mainstem of Wet Walnut Creek is subject to heavy sedimentation. The average sediment yield for the basin is 108 acre-feet/year.

E. Need for Minimizing Conflicts in Land Use

Increased competition for land and water resources within the area make it important that resource problems be anticipated and that people have the authorities to deal with them. Short and long range comprehensive planning is needed to identify, protect, and enhance important values.

Component Needs

A. Areas of Natural Beauty and Human Enjoyment

A small town shade tree restoration program

Creation of open space public-use areas

B. Biological Resources

Full utilization of certain wetlands within the watershed should be accomplished.

Improve ground water management.

Improvement of fish and wildlife habitat.

Preserve existing riparian habitat.

C. Historical and Archeological Sites

Preservation of historical sites.

Preservation or notation of archeological sites that may be involved with future development areas.

D. Land, Water and Air Quality

Establish proper management systems on lands within the watershed.

E. Conflicts in Land Use

Establish a comprehensive land use plan.

Environmental Quality Plan Elements

A. Management, protection, enhancement, and creation of areas of natural beauty and human enjoyment.

1. Establish a shade tree development program for 13 rural towns.

   Installation by: Towns

   Technical Assistance by: Department of State and Extension Forestry

   Cost: $25,000; $2,000 OM&R

2. Establish 700 farmstead windbreaks and 160 acres of shelterbelts.

   Installation by: Landowners, Department of State and Extension Forestry, Agricultural Stabilization and Conservation Service

   Technical Assistance by: Department of State and Extension Forestry

   Cost: Included in land treatment ($45,000)

3. Rehabilitate 30 farmstead windbreaks.

   Installation by: Landowners (cost sharing program needed)

   Technical Assistance by: Department of State and Extension Forestry

   Cost: Included in land treatment ($2,000)

4. Establish 4 open space public use areas by purchasing and developing 1,737 acres. Establish within these areas 4 separate developments including a total of 322 acres in resevoirs, 644 acres of public use area, and 771 acres in buffer zones.

   Installation by: Kansas Forestry, Fish and Game Commission, Bureau of Outdoor Recreation, State Park and Resources Authority

   Technical Assistance by: Same as above

   Cost: $1,996,600 $40,100 OM&R

B. Management, preservation, and enhancement of especially valuable or outstanding biological resources or ecosystems.

1. Survey the occurrence of endangered and threatened species and their habitat needs.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $9,000

2. Establish 3 outdoor classroom educational facilities encompassing a total of 60 acres.

   Installation by: School districts

   Technical Assistance by: Soil Conservation Service, Extension Forestry, Educational Institutions, Kansas Forestry, Fish and Game Commission, and Kansas Advisory Council on Environmental Education

   Cost: $18,000; $1,000 OM&R

3. Obtain easements on 3,150 acres of Type 1 and 2 wetlands in Subwatershed Nos. 4 and 5.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Same as above

   Cost: $157,500

4. Increase land use diversity on 70,000 acres of cropland by using variable cropping patterns to provide increased edge effect and habitat diversity.

   Installation: Landowners

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $35,000; $1,800 OM&R

5. Establish an extensive ground water management program including regulated withdrawl and a system of 44 recharge structures and 4 multipurpose (recharge - public use) strucutres to improve 265 miles of stream aquatic habitat.

   Installation by: Watershed district, Kansas Water Resources Board, Kansas Forestry, Fish and Game Commission, (Ground Water Management District needed)

   Technical Assistance by: Kansas Water Resources Board, Kansas Forestry, Fish and Game Commission USGS, Soil Conservation Service

   Cost: (48 sites) $11,872,100; $42,000 OM&R

6. Obtain easements on 11,000 acres of existing riparian habitat.

   Installation by: Kansas Forestry, Fish and Game Commission, Landowners (Cost sharing program needed)

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $600,000

7. Protect 20 miles of existing stream aquatic habitat from sedimentation by removal of major obstructing log jams.

   Installation by: Landowners, Watershed district

   Technical Assistance by: Department of State and Extension Forestry, Kansas Forestry, Fish and Game Commission, Soil Conservation Service

   Cost: $15,000; $500 OM&R

C. Management, preservation, and enhancement of archeological and historical resources.

1. Survey construction and development sites to determine location, significance, and salvage requirements of archeological sites.

Installation by: National Park Service

Technical Assistance by: State Archeologist, National Park Service

Cost: $10,000

2. Identify and encourage preservation of unique architectural and historical sites.

Installation by: State and local historical societies

Technical Assistance by: State Historical Society

Cost: (not determined)

D. Quality considerations of water, land, and air resources.

1. Install land treatment measures and establish proper management systems to accomplish 100 percent watershed protection. Remaining needs include treatment of 257,000 acres of cropland, 124,500 acres of rangeland, 1700 acres of woodland, and 5000 acres other land.

Installation by: Landowners, Agricultural Conservation Program

Technical Assistance by: Soil Conservation Service, Department of State and Extension Forestry

Cost: $5,773,900; $863,000 OM&R

E. Avoid irreversible and irretrievable commitments of resources.

1. Establish a comprehensive plan including land and water use for each county within the basin.

Installation by: Cities and counties

Technical Assistance by: KDED

Cost: $60,000

Effects of Environmental Quality Plan

A. Areas of Natural Beauty and Human Enjoyment

The beauty of small towns within the watershed will be enhanced due to a shade tree restoration program. Rural area beauty and aesthetics will be improved through application of land treatment practices and windbreak and shelterbelt restoration or establishment. Flood plain area natural beauty will be maintained through preservation of the riparian habitat.

The creation of four public use areas will provide needed facilities for water-based recreation. The public developments will provide facilities for 53,100 sightseers, 19,200 picnickers, 41,900 fishermen, 1,800 boaters, and 14,000 campers, totalling 130,000 recreation days annually. Acquisition of areas associated with the developments will provide 966 acres for dams, reservoirs, and facilities and 771 acres of open space for public use. Creation of the developments will cause disruption in the tranquility of the rural environment by 130,000 recreation days annually.

B. Biological Resources

Terrestrial wildlife habitat in 40 acres of windbreaks will be improved due to rehabilitation. An additional 860 acres will be created through establishment of new windbreaks and shelterbelts.

Conservation land treatment on 388,200 acres of agriculture land and land use diversity on 70,000 acres of cropland will improve terrestrial wildlife habitat.

The existence and habitat needs of endangered and threatened species within the watershed will be identified.

The creation of 48 reservoirs will inundate 2,030 acres of terrestrial wildlife habitat and 51, 9, and 7 miles of ephemeral, intermittent, and perennial stream aquatic habitat respectively. The structures will create 2,030 acres of impounded aquatic habitat. Maintenance of flow will improve 142 and 123 miles of intermittent and perennial stream aquatic habitat respectively. Associated riparian habitat will also be improved.

Eleven thousand acres of riparian habitat and 3150 acres of Type 1 and 2 wetlands will be preserved.

The environmental education of young people within the area will be enhanced through use of outdoor classrooms.

C. Historical and Archeological Sites

Significant historical and archeological sites within the watershed would be identified.

D. Land, Water, and Air Quality

The application of land conserving practices on 257,000 acres of cropland, 124,500 acres of rangeland, 1,700 acres of woodland, and 5,000 acres of other land would bring 100 percent of the watershed under conservation treatment. Land treatment measures will reduce sediment yield from 108 acre feet per year to 78 acre feet per year. Land treatment plus 48 reservoirs will reduce sediment yield to 52 acre feet per year.

E. Irreversible and Irretrievable Commitments

Reservoirs will convert 1,419 acres of cropland; 2,766 acres of rangeland; and 51, 9, and 7 miles of ephermeral, intermittent, and perennial stream aquatic habitat respectively to reservoir pools, dams, spillways, and public use areas.

F. Conflicts in Land Use

Implemented land and water use planning for the watershed area will provide the authority to deal with conflicts in the use of the resources. Important environmental values will be recognized and protected through implementation of the plan.

# SECTION III

of

ADDENDUM

for

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

Display of Selected Plan

in

National Economic Development Account

Regional Development Account

Social Well-Being Account

Environmental Quality Account

SELECTED PLAN

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects (average annual dollars) | Components | Measure of effects (average annual dollars) |
|---|---|---|---|
| Beneficial effects | | Adverse effects | |
| A. The value to users of increased outputs of goods and services | | A. The value of resources required for a plan | |
| 1. Flood damage reduction | 58,700 | 1. 2 multipurpose reservoirs and 7 single purpose flood prevention reservoirs | |
| 2. More intensive use | 9,700 | Project Installation[a/] | 97,800 |
| 3. Recreation | 140,000 | Project Administration[a/] | 28,400 |
| | | OM&R | 26,800 |
| Total Beneficial Effects | 208,400 | Total Adverse Effects | 153,000 |
| | | Net Beneficial Effects | 55,400 |

a/ Amortized for 100 years at 6 1/8 percent interest

December 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects (average annual dollars) | |
|---|---|---|
| A. Income | Region | Rest of Nation |
| Beneficial effects | | |
| 1. The value of increased output of goods and services to users residing in the region | | |
| a. Flood damage reduction | 58,700 | |
| b. More intensive use | 9,700 | |
| c. Recreation | 70,000 | 70,000 |
| d. Secondary | 30,300 | |
| Total Beneficial Effects | 168,700 | 70,000 |

| Components | Measure of effects (average annual dollars) | |
|---|---|---|
| A. Income | Region | Rest of Nation |
| Adverse effects | | |
| 1. The value of resources contributed from within the region to achieve the output | | |
| a. 2 multipurpose reservoirs and 7 single purpose flood prevention reservoirs | | |
| Project Installation[a] | 19,000 | 78,800 |
| Project Administration[a] | 4,400 | 24,000 |
| OM&R | 3,600 | 23,200 |
| Total Adverse Effects | 27,000 | 126,000 |
| Net Beneficial Effects | 141,700 | |

a/ Amortized for 100 years at 6 1/8 percent interest

December 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects | |
|---|---|---|
| | Region | Rest of Nation |
| B. Employment | | |
| Beneficial effects | | |
| 1. Increase in the number and type of jobs | | |
| a. Employment for project construction | 26 man years semiskilled | |
| | 9 man years unskilled | |
| b. Employment for project OM&R | 2 man years unskilled annually | |
| Total Beneficial Effects | 2 permanent unskilled jobs | |
| | 26 semiskilled jobs for 1 year | |
| | 9 unskilled jobs for 1 year | |

| Components | Measure of effects | |
|---|---|---|
| | Region | Rest of Nation |
| B. Employment | | |
| Adverse effects | | |
| 1. Decrease in the number and type of jobs | | |
| Total Adverse Effects | 0 | |
| Net Beneficial Effects | 2 permanent unskilled jobs | |
| | 26 semiskilled jobs for 1 year | |
| | 9 unskilled jobs for 1 year | |



September 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects | |
|---|---|---|
| | Region | Rest of Nation |
| C. Population Distribution | | |
| Beneficial effects | Creates 26 semiskilled jobs for 1 year | |
| | Creates 9 unskilled jobs for 1 year | |
| | Creates 2 man years permanent employment annually | - |
| Adverse effects | - | - |
| D. Regional Economic Base and Stability | | |
| Beneficial effects | Provides floodwater damage reduction for 31,103 acres | |
| | Creates 2 man years of unskilled employment annually | |
| | Creates 26 short-term semiskilled and 9 short-term unskilled jobs | |

A.18

SELECTED PLAN

SOCIAL WELL-BEING ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects |
|---|---|
| Beneficial and adverse effects | |
| A. Real income distribution | 1. Create 35 man years low to medium income jobs for area residents during construction. |
| | 2. Create 2 man years annually low to medium income employment in association with operation and maintenance of the works of improvement. |
| | 3. Create regional income benefit distribution of $168,700. Family incomes are distributed:<br>Under $3,000 — 16%<br>$3,000 to $10,000 — 59%<br>Over $10,000 — 25%<br>It is assumed that benefits will be distributed at about the same percentages. |
| | 4. Local costs to be borne by the watershed region total $27,000. Costs to be distributed by about the same ratio as benefits. |
| B. Life, health, and safety | 1. Provide a sense of economic security and the psychological security associated with the abatement of a fear of flooding. |
| C. Recreation opportunities | 1. Create 70,000 recreation visits. Fifty percent of these will be utilized by visitors from outside the watershed. |

# SELECTED PLAN
# ENVIRONMENTAL QUALITY ACCOUNT
# WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects |
|---|---|
| Beneficial and adverse effects | |
| A. Open and green space, lakes, and other areas of natural beauty | 1. Create two lakes with 182 surface acres for water-based recreation open to the public. |
| | 2. Create 7 floodwater retarding structures and 10 detention dams with a total of 264 surface acres on private land. |
| | 3. Create 1,067 acres for multi-purpose use including public recreation and open and green space. |
| | 4. Improve rural area beauty on 37,620 acres of agricultural land by the application of land treatment practices. |
| | 5. Increase traffic, litter, and noise in a sparsely populated rural community from 70,000 visitor days annually. |
| | 6. Nineteen reservoir structures will increase landscape diversity. |

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects |
|---|---|
| Beneficial and adverse effects | |
| B. The quality of water, land, and air resources | 1. Reduce flooding on 15,803 acres of flood plain land on project and 15,300 acres below the project. |
| | 2. Reduce flood damage 49 percent. |
| | 3. Reduce delivery of sediment to the Arkansas River 12,800 tons annually. |
| | 4. Reduce average annual erosion rate on cropland from 6.8 tons to 4.3 tons per acre. |
| | 5. Reduce average annual erosion rate on rangeland from 1.8 tons to 1.4 tons per acre. |
| | 6. Prolong stream flow following periods of above normal rainfall. |

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects |
|---|---|
| Beneficial and adverse effects | |
| C. Archeological, historical, biological, and geological resources and selected ecological systems | 1. Create water areas of 446 acres where waterfowl resting and feeding will occur. |
| | 2. Improve wildlife habitat through establishment of enhancement measures adjacent to structural measures. |
| | 3. Wildlife habitat will be improved through application of land treatment practices on 37,620 acres. |
| | 4. Create 446 acres of reservoir aquatic habitat. |
| | 5. Inundate 446 acres of terrestrial wildlife habitat. |
| | 6. Reduced use of 1,175 acres of terrestrial wildlife habitat during periodic inundation of reservoir flood pools. |
| | 7. The use of 277 acres of terrestrial wildlife habitat to be occupied by dams and spillways will be temporarily interrupted. |
| | 8. Inundate two miles of perennial and 19 miles of ephemeral stream channel habitat. |
| | 9. Change 8 miles of intermittent stream to perennial and 10 miles of ephemeral stream to intermittent. |

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 1, KANSAS

| Components | Measure of effects |
|---|---|
| Beneficial and adverse effects | |
| D. Irreversible or irretrievable commitments | 1. Commit 72 acres cropland and 374 acres rangeland to sediment and recreation pools. |
| | 2. Commit 238 acres cropland and 59 acres rangeland to dams and spillways. |
| | 3. Commit 433 acres cropland and 268 acres rangeland to recreation land. |
| | 4. Inundate 2 miles of perennial and 19 miles of ephemeral stream. |
| | 5. Change 8 miles of intermittent stream to perennial and 10 miles of ephemeral stream to intermittent through increased base flows. |

WATERSHED PLAN AGREEMENT

between the

WET WALNUT CREEK WATERSHED JOINT DISTRICT NO. 58
Local Organization

BARTON COUNTY CONSERVATION DISTRICT
Local Organization

RUSH COUNTY CONSERVATION DISTRICT
Local Organization

KANSAS FORESTRY, FISH AND GAME COMMISSION
Local Organization

(hereinafter referred to as the
Sponsoring Local Organizations)

State of Kansas

and the

Soil Conservation Service
United States Department of Agriculture

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Wet Walnut Creek Subwatershed No. 1, State of Kansas, under the authority of the Watershed Protection and Flood Prevention Act (P. L. 566, 83rd Congress; 68 Stat. 666) as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Wet Walnut Creek Subwatershed No. 1, State of Kansas, hereinafter referred to as the watershed plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed plan, and further agree that the works of improvement as set forth in said plan can be installed in about seven years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed plan:

1. The Sponsoring Local Organizations will acquire such land rights as will be needed in connection with the works of improvement. The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

| Works of Improvement | Sponsoring Local Organizations (Percent) | Service (Percent) | Estimated Land Rights Cost (Dollars) |
|---|---|---|---|
| Multipurpose Str. Nos. 1 and 4 and recreational facilities | | | |
| Payment to landowners for about 1067 acres | 50 | 50 | 213,400 |
| Legal fees, survey costs, flowage easements, and other | 100 | 0 | 15,300 |
| 7 Floodwater Retarding Structures | 100 | 0 | 108,000 |

The Sponsoring Local Organizations agree that all land acquired or improved with P.L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The sponsoring local organization assures that comparable replacement dwellings will be available

for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the sponsoring local organization and the Services as follows:

| | Sponsoring Local Organizations (Percent) | Service (Percent) | Estimated Relocation Payment Costs (Dollars) |
|---|---|---|---|
| Relocation Payments | 54.0 | 46.0 | 20,000 |

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

| Works of Improvement | Sponsoring Local Organizations (Percent) | Service (Percent) | Estimated Construction Cost (Dollars) |
|---|---|---|---|
| 6 Floodwater Retarding Structures | 0 | 100 | 488,200 |
| Floodwater Retarding Structure No. 2 | 13.5 | 86.5 | 98,700a/ |
| Multipurpose Structure No. 1 | 5.9 | 94.1 | 227,000 |
| Recreational Facilities | 50 | 50 | 41,800 |
| Multipurpose Structure No. 4 | 4.6 | 95.4 | 201,700 |
| Recreational Facilities | 50b/ | 50c/ | 41,200 |

a/ Includes $13,300 nonproject cost.

b/ The Sponsoring Local Organizations will provide the equipment and labor necessary for installation of the recreational facilities.

c/ The Service will provide materials necessary for installation of the recreational facilities.

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

| Works of Improvement | Sponsoring Local Organizations (Percent) | Service (Percent) | Estimated Engineering Costs (Dollars) |
|---|---|---|---|
| 6 Floodwater Retarding Structures | 0 | 100 | 69,800 |
| Floodwater Retarding Structure No. 2 | 13.5 | 86.5 | 13,800a/ |
| Multipurpose Structure No. 1 | 0 | 100 | 32,200 |
| Recreational Facilities | | | |
| Layout design | 100 | 0 | 3,200 |
| On-Site planning and standard designs | 0 | 100 | 1,000 |
| Multipurpose Structure No. 4 | 0 | 100 | 28,800 |
| Recreational Facilities | | | |
| Layout design | 100 | 0 | 3,200 |
| On-Site planning and standard designs | 0 | 100 | 1,000 |

a/ Includes $1900 nonproject cost.

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be $71,300 and $391,900 respectively.

7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed plan.

9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and

improvement of the watershed. Detention dams will be operated and maintained by landowners at their own expense through agreements with the watershed district.

10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed plan is contingent on the availability of appropriations for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organizations have failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organizations in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organizations or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. An

amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor(s) having specific responsibilities for the particular structural measure involved.

14. No member of or delegate to congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1 - 15.12), which provide that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued notification of approval and authorizes assistance.

WET WALNUT CREEK WATERSHED
JOINT DISTRICT NO. 58 — By s/Lloyd E. West
Local Organization

Title President

Box 207, LaCrosse, Ks. 67548
Address Zip Code — Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the WET WALNUT CREEK WATERSHED JOINT DISTRICT NO. 58
Local Organization

adopted at a meeting held on March 18, 1976

s/Lawrance Richards — Box 207, LaCrosse, Ks. 67548
Secretary, Local Organization — Address Zip Code

Date May 13, 1976

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BARTON COUNTY CONSERVATION
DISTRICT — By s/Larry Panning
Local Organization

Federal Office Bldg. — Title Chairman
Great Bend, Ks. 67530
Address Zip Code — Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the BARTON COUNTY CONSERVATION DISTRICT
Local Organization

adopted at a meeting held on April 13, 1976

Federal Office Bldg.
s/Ramona Dunlap — Great Bend, Ks. 67530
Secretary, Local Organization — Address Zip Code

Date May 13, 1976

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RUSH COUNTY CONSERVATION DISTRICT
Local Organization

By s/Robert D. Hanhardt

Title Chairman

Box A, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the RUSH COUNTY CONSERVATION DISTRICT
Local Organization

adopted at a meeting held on May 3, 1976

s/Velmer Wilhelm
Secretary, Local Organization

Box A, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

KANSAS FORESTRY, FISH AND GAME COMMISSION
Local Organization

By s/Richard D. Wettersten

Title Director

Box 1028, Pratt, Ks. 67124
Address Zip Code

Date May, 1976

The signing of this agreement was authorized by a resolution of the governing body of the KANSAS FORESTRY, FISH AND GAME COMMISSION
Local Organization

adopted at a meeting held on May, 1976

s/Jerome Salyer
Secretary, Local Organization

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Date May, 1976

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

s/Robert K. Griffin
State Conservationist

May 13, 1976
Date

# WATERSHED PLAN

## Wet Walnut Creek Subwatershed No. 1

## Barton and Rush Counties Kansas

Prepared Under the Authority of the
Watershed Protection and Flood Prevention Act
(Public Law 566, 83rd Congress; 68 Stat. 666) as amended

Prepared by

Barton County Conservation District
Rush County Conservation District
Wet Walnut Creek Watershed Joint District No. 58
Kansas Forestry, Fish and Game Commission

With Assistance by

U. S. Department of Agriculture

Soil Conservation Service
Forest Service

State of Kansas

Conservation Commission
Water Resources Board
Office of the Kansas State and Extension Forester

April 1976

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## SUMMARY OF PLAN

Subwatershed No. 1 covers 227 square miles in west-central Kansas in Barton and Rush Counties. It is one of five watersheds which were planned jointly. It is sponsored by the Wet Walnut Creek Watershed Joint District No. 58, Rush and Barton County Conservation Districts, and the Kansas Forestry, Fish and Game Commission.

The major problem in the watershed is flood damage along Wet Walnut Creek. Average annual direct floodwater damages in the watershed are estimated to be $380,500 of which 87 percent is crop and pasture damage. Other problems are erosion, sedimentation, and a shortage of water-based public recreational areas.

The proposed watershed project will consist of land treatment and structural measures. Adequate land treatment will be implemented on 28,800 acres of cropland, 8,600 acres of rangeland, and 220 acres of forest land. Land treatment measures include 10 detention dams. Seven floodwater retarding structures and two multipurpose structures for both floodwater retardation and public recreation will be constructed. The Kansas Forestry, Fish and Game Commission will develop the recreational facilities at the multipurpose structures.

Average annual flood damage will be reduced 49 percent. The average annual soil loss in the watershed will be reduced from 5.6 tons per acre to 3.6 tons per acre. Average annual sediment yield from this watershed to Wet Walnut Creek will be reduced by 13,400 tons. Average annual recharge will be increased 2,300 acre feet.

The major impact on the quality of water in Wet Walnut Creek will be the reduction of sediment load. Other impacts of the watershed project on the quality of streamflow will be minimal and localized. Increased base flows, decreased sediment concentration, and reduced erosion will increase fish habitat and food and water for all forms of wildlife in the watershed.

Aquatic habitat will, as a general rule, be improved with the impoundment and management of water in the sediment pools and multipurpose pools. Impoundments will increase both the fishery potential and the amount of suitable habitat for migratory waterfowl. Initially there will be loss of terrestrial wildlife habitat. Land treatment measures will increase wildlife cover and habitat diversity. Multipurpose structureszwill increase public recreational opportunities. In addition, the impounded areas will increase landscape diversity.

A seven year period will be required for project installation. Installation costs will be $3,893,000 of which $1,791,300 will be P. L. 566 funds.

Land treatment measures will be maintained by individual landowners and operators through agreement with conservation districts. Wet Walnut Creek Watershed Joint District No. 58 will be responsible for the operation and maintenance of all floodwater retarding structures and the structural maintenance of the dams and spillways of the multipurpose structures. The Kansas Forestry, Fish and Game Commission will be responsible for the operation and maintenance of the reservoir area and recreational facility areas at the multipurpose structures. The estimated average annual costs of operation and maintenance of structural measures are $26,800. Average annual benefits attributable to structural measures are expected to be $238,700, average annual costs for the measures are estimated at $153,000. Average annual flood damage reduction benefits from land treatment measures are estimated at $62,600.

## WATERSHED RESOURCES--ENVIRONMENTAL SETTING

### Physical Data

Subwatershed No. 1 of the Wet Walnut Creek Watershed Joint District No. 58 is in Barton and Rush Counties in west-central Kansas. It covers an area of 227 square miles. 1/* It is the lower of five subwatersheds which comprise the 1,595 square mile watershed district. Incorporated cities in the watershed are Albert, Otis, Timken, Bison, Heizer, Olmitz, and LaCrosse. The watershed population in 1970 was 5,914 of which 2,824 lived in cities.2/ The city of Great Bend is just east of the watershed.

* See list of references

The watershed is in the Arkansas-White-Red water resources region and the Arkansas River in Kansas subregion.3/ It is along the northern border of these regions. The watershed experiences periods of too little or too much water which typifies these regions.

The major problem in the watershed is flood damage along the mainstem of Wet Walnut Creek. The towns are all located near the edge of the flood plain. While there is damage to streets, yards, and some homes, there is little danger of loss of life. Sheet erosion in the upland drainage areas and scour in the flood plains are problems. Sediment deposition in ponds, reservoirs, and stream channels is a problem. Rapid expansion of irrigation has occurred on the flood plain, but continued expansion could be limited by a decreasing water supply. Recreational opportunities related to water are limited.

The watershed lies within the natural land resource area known as the Blue Hills Section of the Dissected High Plains portion of the Great Plains physiographic province.4/ The altitude of the land surface ranges from 2,232 feet in the northwest corner to 1,865 feet at the watershed outlet. Maximum relief is 367 feet but local relief seldom exceeds 100 feet.

The watershed is in the Harney-Uly-Wakeen soil association as shown on the general soil map of Kansas.30/ Soils on the nearly level and gently sloping uplands are mostly of the Harney and Uly series. These are deep, well-drained soils formed in calcareous loess. The Harney soil has a silt loam surface layer over a silty clay loam subsoil that has moderately slow permeability. Uly has a silt loam surface layer over a moderately permeable silt loam subsoil. Soils on steeper slopes are classified as Penden and Wakeen series with a small but significant component of Bogue and Heizer soils. The deep, well-drained Penden soil has formed in calcareous loamy outwash sediments. It has a clay loam surface layer and moderately permeable clay loam subsoils with a high lime content. The well-drained Wakeen soil is about three feet deep over chalky limestone. It is calcareous silty clay loam throughout. Subsoil permeability is moderate. The Heizer soil is like Wakeen but less than twenty inches deep over chalky limestone. The Bogue soil is a very slowly permeable clay throughout and is underlain by dark gray clay shale at about thirty inches depth.

Soils formed in alluvial sediments of the stream valleys throughout the watershed are classified as Roxbury and Bridgeport series on the lower flood plains and as Hord and Detroit series on higher areas. Roxbury and Bridgeport soils are similar but Roxbury has dark colors extending to a much greater depth than Bridgeport. They are deep, well-drained calcareous soils with silt loam surface layers and moderately permeable silt loam subsoils. The deep, well-drained Hord soil has a silt loam surface layer and moderately permeable silt loam subsoil. Free lime occurs in the soil below depths of forty inches. The deep, well-drained Detroit soil has a silty clay loam surface layer over slowly permeable silty clay subsoil. Free lime occurs below depths of about twenty inches.

The soil survey for Rush County is about fifty percent complete and is scheduled for completion early in 1977. Some surveys on individual farms and ranches are available for Barton County. More information about the soils, their use and management, and other interpretations are in the unpublished manuscripts and in the soils handbook for those surveys not completed. These materials are available at the Soil Conservation Service field office in the county of reference.

The lower valley below Albert is in the Arkansas River lowlands. The area is characterized by a broad alluvial valley and gently to steeply rolling hills.

The relatively flat valley of Wet Walnut Creek varies from one to two miles in width. The oldest exposed rock, the Dakota Formation, outcrops along the southern valley wall near Heizer. Limited outcrops of the Graneros Shale also occur near Heizer. The Greenhorn Limestone is the foundation of the valley walls and uplands. The Carlile Shale occurs as a thin cap on the uplands and is everywhere overlain by undifferentiated quaternary deposits. Quaternary terrace deposits border the north side of the main valley and are extensive in the Dry Creek tributary valley. On those terrace deposits, to the north and northwest of Heizer, are several flat and poorly drained areas.

The normal annual precipitation at Bison is 22.33 inches. During the period of record, the minimum was 12.07 inches in 1956 and the maximum was 38.57 inches in 1973. About 75 percent of the average annual precipitation occurs during the growing season, April through September. High intensity thunderstorms usually occur during spring and summer months,

often resulting in damaging floods. The normal annual temperature is 56 degrees. Average January and July temperatures are 30 and 79 degrees respectively. The average growing season is 174 days. The maximum recorded temperature is 116 degrees while the minimum is -25 degrees.5/

Surfacing material for county roads is found in the chalky or calcareous material and the limestone gravel of the Greenhorn Limestone. Sandstones in the Dakota Formation may be used as loose road material on lightly traveled roads. Small quantities of sand and gravel may be found in the upland Sanborn Formation. The top of the Greenhorn Limestone has been quarried for fence posts and bridge masonry. At the present time this is used for building stone.

Small oil fields and scattered oil wells are found in the watershed and contribute materially to the economy.

The Dakota Formation, overlain by Graneros Shale, Greenhorn Limestone and Carlile Shale, is the chief source of water in the Upland areas. The quantity of water available from this formation is quite variable. Wells tapping only thin, fine-grained sandstones have very small yields. Wells penetrating thicker, more coarsely textured sandstone lenses have yields ranging from a few gallons to a few hundred gallons per minute. The quality ranges from good to too highly mineralized for use.

The Graneros Shale yields little or no water to wells due to its low permeability. Shallow wells in the weathered surface of the Greenhorn Limestone yield meager supplies of water. This water is hard but otherwise of good quality. Very meager supplies of water for domestic and stock use are found in the Carlile Shale. Upland wells generally produce less than 10 to 100 gallons per minute.

Most of the stock and domestic wells in the terrace area are producing from sands and gravels of Quaternary age. Some irrigation wells tapping these deposits yield more than 1,000 gallons per minute. This water contains an excess of iron but is suitable for most uses.

In the Wet Walnut Creek valley, the upper 20 to 30 feet of alluvium consists of silt, clay, and sandy silt, underlain by thick beds of coarse granitic sand and gravel. Thin beds of silt and clay occur locally in the sandy strata. The thickness of the alluvial deposits beneath the Wet Walnut valley, as revealed by test drilling, range from about 40 to nearly 100 feet. The valley alluvium along the northern

border grades into terrace deposits of Quarternary age.

The alluvial sands and gravels in the Wet Walnut Creek valley are highly permeable. Wells that tap them yield large quantities of water. The alluvium is a source of supply for many domestic and stockwater wells, many irrigation wells, and some industrial wells. The yield of valley wells generally exceeds 1,000 gallons per minute. This water is hard but otherwise of good quality.

Land use in the watershed is as follows: cropland, 111,912 acres (77.0 percent); rangeland, 28,681 acres (19.8 percent); forest land, 910 acres (0.6 percent); and miscellaneous, 3,789 acres (2.6 percent).

In the flood plain, 61.2 percent of the 13,686 acres of cropland is irrigated. There are also 175 acres of rangeland, 530 acres of forest land, and 462 acres miscellaneous in the flood plain.

Irrigated cropland in the upland accounts for 2,354 acres of the 98,226 acres of cropland. There are also 28,506 acres of rangeland, 380 acres of forest land, and 3,327 acres of miscellaneous upland.

The only native forest land, largely cottonwood and elm trees occurs in narrow strips along the principal streams.

In its original or virgin condition the major portion of the watershed was natural prairie. This original vegetative community consisted primarily of big bluestem, little bluestem, blue grama, western wheatgrass, and sideoats grama on the uplands. In prairie drainways and bottomland areas the original vegetation was primarily prairie cordgrass, western wheatgrass, big bluestem, indiangrass, and switchgrass.

Following settlement much of the native rangeland was plowed and converted to cropland. Many small pastures were fenced and grazed by livestock including draft animals. Pastures were often heavily grazed year long which altered the vegetative composition. On many pastures the taller grasses were largely replaced by less palatible plants or low growing vegetation which tended to tolerate heavy grazing.

Principal grasses on the uplands are blue grama, sideoats grama, buffalograss, western wheatgrass, tall dropseed,

annual brome, annual threeawn, windmillgrass, silver bluestem, big bluestem, little bluestem, indiangrass, and switchgrass. Forbs and legumes include Louisiana sagewort, western ragweed, heathaster, falsebonset, dotted gayfeather, Missouri goldenrod, whitebract hymenopappus, wavyleaf thistle, blue wildindigo, Illinois bundleflower, and slimflower scurfpea. Woody plants consist primarily of skunkbrush, plum, smooth sumac, and buckbrush.

Major grasses on the lowlands are prairie cordgrass, switchgrass, meadow dropseed, silver bluestem, big bluestem, indiangrass, western wheatgrass, Kentucky bluegrass, blue grama, sideoats grama, buffalograss, eastern gama, Canada wildrye, and several species of sedge. Major forbs and legumes are Baldwin ironweed, tall goldenrod, western ragweed, snow-on-the-mountain, maximilian sunflower, heathaster, poison hemlock, giant ragweed, American licorice, and Illinois bundleflower. Woody plants include osageorange, American elm, black willow, cottonwood, hackberry, indigobush amorpha, and buckbrush.

The flat pothole-marked tableland of eastern Scott County is the headwaters of the north, middle, and south forks of Wet Walnut Creek. The mainstem of Wet Walnut Creek is formed south of Ness City, Kansas. The stream continues eastward and is joined by Dry Walnut Creek just before entering the Arkansas river about four miles east of Great Bend.

Subwatershed No. 1 includes several tributaries to Wet Walnut Creek, the largest is Sand Creek which originates six miles northwest of LaCrosse. Both Wet Walnut Creek and Sand Creek have unmodified, well-defined natural channels. Sand Creek is ephemeral in its upper reaches and intermittent from five miles above its confluence with Wet Walnut Creek to Wet Walnut Creek. Ephemeral streams flow only during periods of general runoff. Intermittent streams have periods of continuous flow but little or no flow during other times. The upper four miles of Wet Walnut Creek in this watershed are intermittent. The remainder of Wet Walnut Creek in this watershed is perennial. Perennial streams flow at all times except during extreme drought.

There are no types 3 through 20 wetlands in the watershed extensive enough to be included in the U.S. Fish and Wildlife Service inventory for Kansas.6/

The Kansas Department of Health and Environment has developed surface water quality criteria. The Department states that the high incidence of low flows in Wet Walnut Creek inhibit detailed water quality analyses and the application of water quality criteria.7/

Suspended sediment discharge records have been collected from Wet Walnut Creek at Albert since 1963.8/ The average annual sediment load for the period of record is 83,385 tons (64 tons per square mile). The annual sediment load ranged from 242,119 tons (185 tons per square mile) in 1967 to 21,064 tons (16 tons per square mile) in 1964. The mean annual sediment yield for Kansas streams ranges from 50 to more than 5,000 tons per square mile.

The Kansas Department of Health and Environment and the U.S. Geological Survey have made chemical analyses of water in the Wet Walnut Creek at Albert since 1962.8/ The maximum recorded water temperature was 31 degrees Celsius (7-21-63), the maximum daily sediment concentration was 7,500 milligrams per liter (mg/l), (9-13-66), and the maximum daily sediment discharge was 16,300 tons (7167). The average concentration of dissolved solids in 140 samples of water collected for chemical analysis was 479 mg/l; the concentration range was 147 mg/l (82669) at a discharge of 718 cubic feet per second (cfs) and 944 mg/l at a discharge of 0.34 cfs.

The following tabulations display selected chemical analyses for storm runoffs, the highest and lowest concentrations recorded, and the average of the analyses for the period of record, 1962-1974.

CHEMICAL ANALYSES OF STREAMFLOW AT ALBERT, KANSAS[10/]

Concentrations (mg/l)

| Date | Significance | Discharge (cfs) | $SiO_2$ | $Fe^{++}$ $^{+++}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $HCO_3^{-}$ | $CO_3^{=}$ | $SO_4^{=}$ | $Cl^{-}$ | $F^{-}$ | $NO_3^{-}$ | $PO_4^{\equiv}$ | B | Dissolved Solids Residue | | Ratio Specific Conductance to Dissolved Solids | Specific Conductance | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | Calculated | Measured | | | |
| 5/24/65 | Storm Flow | 280.00 | 18 | - | 99 | 12.0 | 63.0 | 21.0 | 373 | 0 | 68.0 | 59 | .4 | 2.20 | N.M. | .190 | 526 | 536 | 1.59 | 850 | 7.3 |
| 7/5/67 | Storm Flow | 606.00 | 14 | - | 53 | 3.9 | 7.0 | 8.1 | 166 | 0 | 15.0 | 9 | .4 | 5.80 | N.M. | .080 | 198 | 215 | 1.44 | 310 | 7.6 |
| 8/26/69 | Storm Flow, also lowest concentration | 718.00 | 12 | - | 46 | 2.2 | 4.5 | 10.0 | 151 | 0 | 8.6 | 6 | .4 | 2.90 | .69 | .011 | 93 | 174 | 1.55 | 270 | 7.6 |
| 12/17/70 | Highest concentration, also a low flow | .34 | 21 | - | 200 | 18.0 | 95.0 | 13.0 | 476 | 0 | 120 | 210 | .2 | .40 | .51 | - | 678 | 944 | 1.67 | 1,580 | 7.8 |
| 7/26/73 | Storm Flow | 1,430.00 | 15 | N.M. | 42 | 3.6 | 5.0 | 10.0 | 130 | 0 | 17.0 | 9 | .3 | .61 | N.M. | .012 | 166 | 188 | 1.49 | 280 | 7.3 |
| | Average 1962-1974 | 44.00 | 18 | .01 | 101 | 13.2 | 39.3 | 12.3 | 297 | 0 | 84.0 | 50 | .4 | 1.71 | 0.51 | .160 | 466 | 479 | 1.57 | 751 | 7.7 |

There is good agreement between calculated and measured dissolved solids. The greatest deviation occurs at extremely high and low flows. The same is true of the ratio of specific conductance to dissolved solids. The carbonate ion was measureable in only one analysis, June 4, 1968;8/ the recorded pH was 8.4. Calcium and sodium have the largest deviations of the anions and bicarbonate, sulfate, and chloride the largest deviations of the cations. The other measured ion are relatively consistent.

Nitrate as nitrogen does exceed recommended limits to control growth of plants in streams and lakes.36/ However, nitrogen and phosphorous must be present in the proper proportions to induce eutrophic conditions and turbidity is known to retard plankton growth.37/ Excessive plant growth does not occur in the watershed streams.

One chloride concentration in excess of surface water criteria was recorded in March of 1967 - 2,190 mg/l. This and other relatively high recorded chloride concentrations are probably due to brine spills from oil well operations.

All measured factors with the exception of dissolved solids and chlorides were within the limits of current acceptable surface water quality stnadards.

Concentrations appear to vary according to a number of factors; among which are antecedent moisture, time of year, and storm intensity. The streamflow of Wet Walnut can be classified as the calcium bicarbonate type. The primary constituents of storm runoff are (1) sediment, (2) bacteria and other microorganisms, (3) dissolved and suspended organic material, and (4) nutrients.

Economic Data

Land in the watershed is privately owned except for a small amount used for roads, public buildings and similar purposes. The average size farm in the watershed is 311 acres. Fiftysix percent of the land is operated by owners. There are 467 farms in the watershed.

Farming operations in the watershed are primarily centered around wheat, grain sorghums, and corn. Some corn and sorghums are used for livestock production. Alfalfa is grown under irrigation on some of the flat bottom land near Wet Walnut Creek and on a limited basis without irrigation in other portions of the watershed.

Principal Crops and Current Yields

| | Unit | Flood Plain (flood free) | | Upland |
|---|---|---|---|---|
| | | Dryland | Irrigated | |
| Wheat | Bu | 27 | 45 | 21 |
| Sorghum | | | | |
| Grain | Bu | 42 | 133 | 41 |
| Silage | Tn | 13 | 20 | 10 |
| Corn | Bu | -- | 115 | -- |
| Soybeans | Bu | 20 | 35 | -- |
| Alfalfa | Tn | 3.5 | 5 | 3.5 |

The number of farms in the watershed is decreasing at a rate of one percent per year or less as the trend toward larger farms continues.

Land values in the watershed range from $750 for flood plain and irrigated and level cropland, $300 for upland cropland, and $200 for rangeland.11/

Selected economic data for 1969 includes:32/

| | Watershed | State of Kansas |
|---|---|---|
| Median Family Income | $7,532 | $8,693 |
| Families with Incomes below Poverty Level | 13.0% | 9.7% |
| Unemployment Level | 3.2% | 3.9% |
| Family Income Distribution | | |
| Less than $3,000 | 16.0% | 11.0% |
| $3,000 to $10,000 | 59.0% | 49.0% |

The source of income is generally sale of agricultural products. There are 86 family farms in the flood plain.

There is a good road grid in the watershed. Kansas Highway 96 parallels the Wet Walnut flood plain and U.S. 183 crosses the watershed. State Highway 4 is an east-west road in the northern portions. The Atchison, Topeka, and

Santa Fe and Missouri Pacific Railroads both serve the watershed. These transportation facilities provide access to markets.

The watershed population in 1970 was 5,914. Small town population amounted to 2,824 persons while rural farm population amounted to 3,090 persons. By the year 2000, town population is projected to be 3,036 while rural farm population will be 3,275, based on Barton, Lane, Ness, Rush and Scott counties' historical trend.

Fish and Wildlife Resources

Fish habitat is scarce and limited to warm-water species within the watershed. Portions of the mainstem of Wet Walnut Creek contain channel catfish, bullhead catfish, and carp. Privately owned and stocked farm ponds provide fishing opportunities for largemouth bass, black crappie, white crappie, bluegill, carp, drum, channel catfish, and black bullhead catfish.12/ The quality of these resources range from poor to excellent.

Woody wildlife cover, provided by cottonwood, honey locust, red cedar, willow, elm, ash, Russian olive, mulberry, and osageorange, is limited to riparian sites and shelterbelts.13/ These wooded areas, along with the varied understory of shrubs, forbs, and grasses and adjacent croplands, provide critical habitat for upland game, deer, and other wildlife.

The effect of water quality due to increasing sediment load on fish and wildlife resources has generally been damaging. At the present there are 46 miles of perennial streams, 15 miles of intermittent streams, and 418 miles of ephemeral streams in the watershed.

Access is a primary factor limiting use of the fish and wildlife resources. Most of the ponds and the land bordering streams are privately owned. Only sportsmen with landowner permission have access.

Deer hunting, based on permit drawings, occurs in the watershed. Upland game in the watershed include bobwhite quail, mourning dove, ring-necked pheasant, fox squirrel, cottontail rabbit, and black-tailed jackrabbit.12/ Upland game hunting, particularly for ring-necked pheasants, is important throughout the project area. During wet seasons

waterfowl use of potholes is extensive providing excellent hunting and bird watching.

There is no known endangered or threatened plant species in the watershed.14/

The Kansas Academy of Science lists the endangered whooping crane (Grus americana) as a possible transient in the watershed.15/ The American peregrine falcon (Falco peregrinus), another endangered species, may be a transient or winter resident. The bald eagle (Haliaeetas leucocephalus), the prairie falcon (Falco mexicanas), and the burrowing owl (Speotyto cunicularia) are listed as threatened species that might be found within the watershed. Although no recent sightings have been made, the endangered black-footed ferret may also be a resident within the watershed.

The Kansas Academy of Science's endangered or threatened species list contains no known fish, amphibians, or reptiles that might be found within the boundaries of Wet Walnut Creek Watershed.

## Recreational Resources

There are no federal or state recreational developments and water-related recreational opportunities are very scarce in this watershed. The closest major recreational area is the Cheyenne Bottoms Waterfowl Management Area 10 miles east of the watershed which provides mostly hunting and some fishing. Cedar Bluff Reservoir, 35 miles northwest, provides water-based recreational opportunities. Water related recreation within the watershed is limited to farm ponds. During drought periods most farm ponds and streams dry up providing very few waters that will sustain a permanent fish population.

## Archeological and Historical Areas

The archeology of this region has received little systematic investigation in the past. There are 12 reported archeological sites within the region.16/

Data for the locations of previously known archeological sites along Wet Walnut Creek are primarily from the activities of amateurs and collectors reporting their work to the Kansas State Historical Society. The cultural time range known to be represented along Wet Walnut Creek is from the Paleo-Indian period to those of historic Indian tribes of the middle 19th century.

The National Register of Historic Places does not list any sites in this watershed.17/

The Kansas State Historical Society reports that no historical buildings or previously known archeological sites will be affected by the proposed structure.16/ An inventory of archeological resources for the proposed structure locations prepared December 1974 recommended:33/ (1) Testing to provide assessment and priority of archeological investigation for Structure Nos. 1 and 9 and (2) A revisit when collecting and subsurface conditions are more favorable for Structures Nos. 2 and 4. All other proposed structures lack potential for prehistoric materials and no archeological evidence was found.

An assessment of archeological sites recommended by the inventory of December 1974 was made in July and August 1975 by a private archeologist in conjunction with the State Archeologist.9/ Testing at all sites did not reveal sufficient cultural material to warrant further formal archeological investigation.

Soil, Water, and Plant Management Status

There are no major changes in land use trends.

Conservation districts within the watershed are active. There are 331 cooperators, and 311 basic plans have been developed covering 50 percent of the watershed. From 30 to 75 percent of the needed conservation practices have been applied. Forty-seven percent of the cropland and 50 percent of the rangeland has adequate treatment.

Conservation districts receive technical assistance from the Soil Conservation Service. Other agencies with programs affecting land use and treatment in the watershed are the Cooperative Extension Service, and Forest Service, the Agricultural Stabilization and Conservation Service and Farmers Home Administration. The Extension Service, through agricultural extension agents, assists with informational and educational programs to carry out conservation objectives. The Agricultural Stabilization and Conservation Service shares the cost of installing certain permanent practices through it's ACP or other programs. The Farmers Home Administration will make loans for the installation of conservation practices when other funds are not available to the farm operator. Through cooperative agreements with the

Forest Service and the Kansas State and Extension Forester, all of the grassland and woodland acres in the watershed are within rural fire district protection.18/ The Forest Service and the Kansas State and Extension Forester have also assisted in 300 acres of tree and shrub plantings.

The withdrawal of groundwater for irrigation is increasing rapidly. In recognition of declining water tables in some areas in western Kansas, the Kansas Water Resources Board and the U.S. Geological Survey undertook a cooperative study of potential artificial groundwater recharge using as the first study area Wet Walnut Creek in Rush County.19/ The study indicated the pumpage in Rush County was increasing with an average of 11 new wells drilled each year. The report states that the Wet Walnut Creek aquifer depends almost entirely on streamflow for its recharge and that the system is fairly well in balance at present. However, it noted that a long extended drought could seriously deplete the aquifer under present circumstances.

The main valley alluvium is the principal aquifer in the watershed. In Rush County, the aquifer is recharged by subsurface inflow from the west and tributary valleys on the north and south, and by seepage losses from Wet Walnut Creek and tributary creeks during periods of high flow.28/ The maximum potential for storage of recoverable water in the aquifer is 160,000 acre feet. As of January 1973 the aquifer contained 152,000 acre feet of recoverable water.

As of 1974, the average annual flood plain irrigation withdrawals were 9,000 acre feet. The identified average annual recharge from streamflow was 3,600 acre feet. Subsurface inflow to the Wet Walnut Creek aquifer in Rush County has been estimated as 320 acre feet per year.28/ Since there is no apparent decline in the water table in Barton County, it is thought that the water table in this area is sustained by subsurface inflows. Possible subsurface inflow sources are the Quaternary alluvium common to Wet Walnut Creek, Dry Walnut Creek, the Arkansas River, and the Pleistocene Sanborn Formation. The Pleistocene Sanborn Formation comprises the uplands in Barton County to north of the Wet Walnut Valley.

The months of July and August are the peak demand months for irrigation. The alluvial aquifer is the main source of irrigation waters. This groundwater source is of good quality. Although high chloride contents have been

recorded in chemical analyses of surface waters, the highest values were recorded during non-irrigation months - 209 mg/l - Dec. 1970, 2,190 mg/l - March 1967, 149 mg/l - April 1972, 127 mg/l - March 1974. The highest chloride contents measured during the months of July and August are 32 mg/l - 1963, 11 mg/l - 1965, 50 mg/l - 1967, 7 mg/l - 1969, 19 mg/l - 1971, 87 mg/l - 1973, and 83 mg/l - 1974. Due to the good quality of irrigation water and the characteristics of the irrigated soils, leaching is not a problem. The likely source of the high recorded chloride concentrations are uncontrolled brine spills from oil well operations. Groundwater chemical analysis data is shown in the following table.

The municipal areas of Albert, Bison, Heizer, LaCrosse, Otis, and Timken have a combined average annual groundwater withdrawal of 515 acre feet. The depths of wells supplying this demand range from 42 to 150 feet. Due to the maintenance of the water table by unidentified inflows, there is no conflict with withdrawals for irrigation.

A power plant near Heizer has an existing water right for withdrawing 542 acre feet per year. This is not a major industrial area. Any industrial development will probably continue to emphasize small industries that furnish local services and process agricultural products. It appears that there will be no appreciable increased demand for additional water supplies in the watershed for municipal and industrial use in the near future.

Chemical Analyses of Ground Water in Milligrams Per Liter[29/]

| Location | Date | $SiO_2$ | $Fe^{++}$ $Fe^{+++}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ & $K^{+}$ | $HCO_3^{-}$ | $CO_3^{=}$ | $SO_4^{=}$ | $CL^{-}$ | $F^{-}$ | $NO_3^{-}$ | $PO_4^{\equiv}$ | B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SE SE Sec. 30 T18S, R15W | 10/16/1944 | N.M. | 1.6 | 99 | 13 | 29 | 350 | N.M. | 49 | 17 | .3 | 1.3 | N.M. | N.M. |
| NW NE Sec. 34 T18S, R15W | 10/16/1944 | N.M. | 1.8 | 103 | 14 | 68 | 404 | N.M. | 73 | 38 | .4 | 2.0 | N.M. | N.M. |

| | Dissolved Solids | | Specific Conductance | pH | Hardness as $CaCO_3$ | | | Temperature °C | Source and Depth (ft.) |
|---|---|---|---|---|---|---|---|---|---|
| | Calculated | Measured | | | Total | Carbonate | Non-carbonate | | |
| SE SE Sec. 30 T18S, R15W | 382 | 385 | N.M. | N.M. | 300 | 287 | 13 | 14.4 | Alluvium 35 |
| NW NE Sec. 34 T18S, R15W | 498 | 502 | N.M. | N.M. | 314 | 314 | 0 | 14.4 | Alluvium 30 |

N.M. - Not Measured

## WATER AND RELATED LAND RESOURCE PROBLEMS

### Land and Water Management

Rangeland was first exposed to the plow in the middle 1800's. A gradual increase in cropland has occurred since the first plowing, reaching a maximum around 1938. An active land treatment program began in 1945. However, in 1974 conservation cropping systems were needed on 29,807 acres of cropland; rangeland and woodland conservation practices were needed on 14,831 acres.

Erosion is a problem on cultivated uplands where needed land treatment has not been installed. The average cropland soil loss is 6.8 tons per acre per year. Soil loss results in depletion of soil resources, reduction of farm yields and income, sedimentation in farm ponds and on the flood plain, deterioration of stream quality, and increases in road maintenance costs. Soil fertility is not generally a problem, however low fertility becomes a problem on eroded lands. Available soil moisture is a limiting factor in crop production in most years. Moisture conserving practices such as stubble mulching, terracing, and contour farming are needed on cropland. Excessive tillage operations on many farms reduce ground cover; increase compaction, crusting, and run-off; and uses more fuel than necessary. Land use adjustments needed are mostly cropland to grassed waterways.

Most landowners are economically able to install the needed land treatment with the help of federal cost-sharing programs.

### Floodwater Damage

Damage resulting from flooding (1.5 year frequency or greater event) is the principal watershed problem. Two recent floods stand out in the memories of watershed residents: the floods of 1959 and 1973. Both floods caused major damage to most bottomland in the watershed.

The evaluated flood plain covers 14,853 acres and includes 13,686 acres of cropland. Crop and pasture damage due to flooding averages $332,700 annually and accounts for 70 percent of the total flood damage. Flood durations of usually greater than 48 hours are one of the major causes of damage.

Flood damages occur throughout the flood plain of the watershed. A total of 86 farm units are subject to damage. In the urban areas 113 residential and 24 commercial units with a 1974 value of $1,889,000 located on 205 acres are subject to damage. Urban damages average $25,100 per year: Heizer ($3,500), Albert ($15,200), and Timken ($6,400). While there are some urban damages to streets, yards and some homes, there is little danger of loss of life.

Flooding damages buildings, machinery, fences, cattle and hog pens, feed bunks, and stock tanks. Considerable expenses are incurred for cleanup of debris after flooding. Agricultural damages of this type average about $6,000 annually.

Floodwater damage to roads, railroads, and bridges average $16,700 annually. Floods wash away road surfacing, scour road shoulders, fill road ditches with mud on 16.7 miles of road and damage 12 bridges. County and township budgets are not usually sufficient to make timely replacements and repairs following a flood. The work is necessarily spread over a number of years hence these essential facilities remain in poor condition. At the 100 year frequency flood 3.3 miles of railroad are subject to damage.

Small, localized floods frequently cause considerable damage and inconvenience to farmers in the area. A major flood such as that experienced in 1959 affects everyone in the area due to damaged roads, bridges, utilities, and loss of business to those serving the agricultural community. Such indirect losses are estimated at $44,800 annually.

Flood damages occur on 15,300 acres off project immediately downstream from Subwatershed No. 1 on the Wet Walnut Creek flood plain. Part of this area is comprised of: urban and surburban (320 acres), cropland (9,910 acres), and pasture and miscellaneous lands (2,870 acres). The remainder occurs on flood plain common with the Arkansas River and is comprised of: urban and suburban (680 acres), cropland (1,290 acres), and pasture and other land (230 acres).

The 1959 flood was the largest of record in this watershed. A discharge of 12,700 cfs was recorded at the Albert gage on September 22 of that year. This flood was the result of a very heavy rain and hail storm which started during the evening of the 20th and continued into the 21st. This storm was preceded by showers for several days so the runoff was

excessive. Precipitation stations in the basin reported rainfall amounts ranging from zero at Great Bend to 6.45 inches at Alexander. A bucket survey after the storm indicated an 11 inch rainfall just west of Bazine and a 9 inch rainfall between Alexander and Rush Center. Wet Walnut Creek was out of its banks throughout the watershed and inundated nearly all of Timken, Albert, and Heizer. This flood caused damages, based on current prices, of almost $1,500,000 within the watershed. The estimated frequency of this flood at Albert is 40 years.

In summary, total average annual direct floodwater damages are estimated at $380,500 as shown in Table 5. There are also unevaluated damages to wildlife in the flood plain area. Seventy-five percent of the storms causing out-of-bank flows occur between April and August. Ground-nesting birds are susceptible to flooding during this period. Flooding destroys protective habitat, nests, and young birds. Terrestrial species in the flood plain may be displaced or destroyed by floods. Displacement and exposure may result in increased predation, starvation, or disease epidemics.

Erosion and Sediment Damage

The highest soil losses occur on cropland. Average annual soil losses from cultivated upland fields range from 2 to 15 tons per acre, averaging 6.8 tons per acre. Some steeply rolling rangeland is gullied. The average annual soil loss from rangeland is 1.8 tons per acre.

Large floods cause considerable flood plain scour damage. The flood that occurred in September of 1959 caused scour damage on 1,197 acres of flood plain. This caused an estimated average production reduction of 17 percent in flood plain yields. The average annual erosion scour damage is $46,400.

High concentrations of sediment limit development of desirable flora and fauna. Murky waters are common in Wet Walnut Creek. The average annual suspended sediment concentration at Albert is 1,200 mg/l.

Flood plain sediment damages are caused by floods. A number of large sediment deposits were noted following recession of floodwater in September in 1959. As a result of this storm, road ditches, culverts, channels and bridge openings were clogged with sediment and debris. In addition, some roads and bridges were covered with sediment.

Annual sediment yield per square mile ranges from 300 to 600 tons in the watershed. An estimated 170,000 tons of sediment are delivered to the Arkansas River annually from the Wet Walnut Creek Basin. This watershed contributes 31,000 tons of sediment annually to the Arkansas River.

In the interval 1932 - 1968, 3,136,000 tons of sediment were deposited in Wet Walnut Creek in this watershed. These deposits have decreased the channel capacity. The native grasses that grew in and along the channel have been smothered by sediment. Elevated stream banks have formed and weeds and trees now grow in the outer channel. Streamflow is retarded by this recent vegetative growth.

The channel fill deposits are primarily silt and clay sized particles. These fine grained deposits decrease infiltration through the channel floor and walls. As a result, channel recharge to the main valley aquifer is diminishing. The continued loss of channel capacity will result in average annual flooding damages of $3,200.

Recreation

The Kansas State Outdoor Recreation Plan indicates that the single most important outdoor recreation need in this area is water. In 1970 the five county area had a population of 48,884. Within a 50 mile radius, about 128,200 people lack sufficient recreation facilities to satisfy needs. By the year 2000, the area's population will be about 137,400. 20/

Fishing in the Wet Walnut Creek is poor because of sediment pollution and low water quantity. Fishing in watershed farm ponds ranges from poor to excellent depending on water quality, permanence, and management. Most fishing is restricted to family and close friends of landowners.

Fish and Wildlife

There is a need for more wildlife habitat, particularly cover, throughout the watershed. A substantial increase in cover would tend to be in competition with agricultural production, although some compatible increases are possible.

Economic and Social

The watershed is not an economically depressed area. It is composed of family farms. None of the farms in the district use one and one-half man years or more of hired labor at present. There is a need to provide additional employment opportunities in order to give young people options other than migration to an urban area. There is a general need to establish rural community development in the watershed.

Other

A need exists for outdoor educational facilities.

## PROJECTS OF OTHER AGENCIES

While there are no major projects proposed by other agencies within the watershed, the Corps of Engineers has an authorized local flood protection project at Great Bend. This project and the watershed projects are complementary. The watershed projects would supplement the protection offered in Great Bend. One effect of the watershed projects will be to reduce the Corps of Engineers standard project storm peak discharge by 35%. The local flood protection project would protect Great Bend from floods on both the Arkansas River and Wet Walnut Creek. The current estimated cost is 18.4 million dollars, of which 3.7 million dollars would be non-federal. Construction of the local flood protection project is pending passage of a bond issue by local voters.

## PROJECT FORMULATION

Subwatershed No. 1 is one of five watersheds in the Wet Walnut Creek Watershed Joint District No. 58 which covers the entire Wet Walnut Creek basin except for the lower few miles. The five watersheds were planned concurrently. One of the watersheds proved economically unfeasible for the P.L. 566 program. The watershed district has complied with applicable Kansas laws in organizing and carrying out their activities.

Shortly after the flood of September 1959, the first steering committee was selected. Interested citizens held their first public meeting May 8, 1961. The 18 banks of the area provided funds for organizing the watershed. Petitions calling for a formal vote were submitted to the Secretary of State May 16, 1963. The first board of directors

was elected July 11, 1963. A favorable vote was taken on October 29, 1963. A Certificate of Incorporation was issued by the Secretary of State November 22, 1963.

An application for federal assistance under Public Law 566 was submitted to the State Soil Conservation Committee September 30, 1964. Approval by the State Soil Conservation Committee was granted December 18, 1964. A joint study of Wet Walnut Creek as part of the Upper Arkansas Basin by the Soil Conservation Service, Forest Service, Economic Research Service, and the Kansas Water Resources Board was started May 4, 1965. The State Soil Conservation Committee assigned a priority for planning July 31, 1967. A groundwater recharge study was started in the Wet Walnut Creek Basin as a cooperative venture of the Kansas Water Resources Board, the U.S. Geological Survey, and the Wet Walnut Creek Watershed District during the summer of 1968.

Preliminary planning led to project formulation meetings in October 1968 where 54 P.L. 566 sites and 45 additional sites were selected to be built with other federal assistance programs over the five watersheds. Most of these sites remain in the plans. Planning was authorized by the Soil Conservation Service Administrator January 13, 1969.

The watershed board of directors maintain an active and continuing interest in promoting conservation of all kinds within the district. They employ a full-time watershed manager and have held regular monthly and annual public meetings throughout the history of the district. In the course of these activities, many alternatives have been considered. The public has had ample opportunity and repeated encouragement to provide inputs into the development of the objectives and project formulation. The local press has given extensive coverage to the activities of the district and the general level of public awareness of the plans is very high.

The General Plan for the Wet Walnut Creek Watershed Joint District No. 58 was approved by the watershed board of directors and the Kansas Division of Water Resources of the State Board of Agriculture March 30, 1972.31/ Modifications were made and approved in February 1973 and January 1974. Well-publicized public hearings were held at each of these steps.

Objectives

Original goals of sponsors were expressed in the applications, dated September 30, 1964. The goals were stated in general terms by types of benefits expected through project action. As planning progressed the goals became more specific and better defined. The redefined goals, including those of the Soil Conservation Service are summarized herein according to project purpose.

Watershed Protection (Conservation Land Treatment): Reduce soil loss on 28,800 acres of cropland and 8,600 acres of rangeland, to allowable levels. The allowable soil loss for a typical upland soil is 5 tons/acre/year.1/

Manage land within its capability. Manage croplands through implementation of conservation practices; conservation cropping systems, stubble mulching, minimum tillage, contour farming, and the installation of terraces, diversions, grassed waterways, and drainage systems. Convert cropland to rangeland where appropriate and improve management practices on existing rangeland. Manage rangelands through proper grazing use, planned grazing systems, brush management, and the strategic location of stock ponds.

Reduce sediment load to a point that no new deposition occurs in the main Wet Walnut Creek channel. The objective is to maintain or improve present capacity and ground water recharge capability of the channel.

Flood Prevention: Reduce average annual flood damages to crops, agricultural properties, roads, bridges and public utilities by 60 percent on 38,500 acres of flood plain within the watershed district. Reduce flooding in urban areas to confine damage to streets, lawns, and parks.

Recreation: Develop two reservoirs with the best physical potential for multipurpose use including recreation. Design facilities for maximum potential use for fishing, boating, sightseeing, picnicking, hunting, and camping.

Fish and Wildlife: Enhance fish and wildlife resources within the watershed through land treatment measures, land use conversions, and establishment of impounded water. Where habitat losses unavoidably occur due to installation of structural measures, they are to be mitigated.

Outdoor Education: Cooperate with school districts to develop outdoor educational areas in conjunction with reservoirs where practical. These areas should be located to serve 2 unified school districts and a junior college.

## Alternatives

The seven alternatives that were considered in formulation of the project plan are displayed in the table on the next page. These alternatives were analyzed for physical feasibility, sources of authority, availability of local sponsors, effect on adverse environmental impacts, viability, and cost. A viable alternative is defined as one which is physically feasible and could be carried out under an existing authority. Cost estimates are included only for viable alternatives that reduce or eliminate adverse impacts of the proposed project.

Alternative No. 1-1 is the same as the proposed project except that the sediment pools of the floodwater retarding structures would be dry. These dry impoundments would result in conversion of 8 miles of ephemeral stream and associated flood plain to 164 acres of frequently flooded odd area habitat. The project, on an average annual basis, would result in 2,000 acre feet of additional groundwater and increased evapotranspiration of 800 acre feet. The aesthetics and incidental benefits associated with the development of 164 acres of aquatic habitat would be foregone. The cost of this alternative would be $3,788,000.

Alternative No. 1-2 is to allow present trends to continue. The existing land treatment program would continue. Net project benefits of $85,700 would be foregone.

Alternative No. 1-3 consists of accelerated land treatment only. Resource management systems would be installed in seven years on 37,620 acres of agricultural land. The average annual soil loss from upland soils would be reduced from 5.6 to 3.6 tons per acre. Average annual sediment deposition in existing ponds would be reduced 25 percent and the average annual sediment yield to the watershed outlet would be reduced from 31,000 tons to 22,000 tons. The cost of this alternative would be $1,836,700.

WET WALNUT CREEK SUBWATERSHED NO. 1

MATRIX ANALYSIS OF ALTERNATIVES (X=yes, 0=no)

| Alternative No. | Description | Alternative Components | | | | | | Physical Feasibility | Authority | | Local Sponsorship | Effect on Adverse Impacts | Viable | Installation Cost ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ACC LT | MP-REC | CW | Z | I | FRS No. | | PL 566 | Other | | | | |
| 1-1 | As planned, but with dry pools | X | 2 | | | | 7 | X | X | X | X | Reduce | X | 3,788,000 |
| 1-2 | No project | | | | | | | X | | X | X | Eliminate | X | 697,800 |
| 1-3 | Acc. L.T. | X | | | | | | X | X | X | X | Eliminate | X | 1,836,700 |
| 1-4 | Acc. L.T. and Non-Structural Measures | X | | | X | X | | X | 0 | 0 | 0 | Eliminate | 0 | |
| 1-5 | Channel Work and Acc. L.T. | X | | X | | | | X | X | X | X | Increase | 0 | |
| 1-6 | Recharge Structures and Acc. L.T. | X | | | | | | X | 0 | X | X | Reduce | X | 2,229,600 |
| 1-7 | As planned with Recharge Structures | X | 2 | | | | 7 | X | X | X | X | Increase | X | |

ACC LT - Accelerated Land Treatment (all alternatives include on-going land treatment)
MP-REC - Multipurpose Floodwater Retarding and Recreation Structure
CW - Channel Work
Z - Flood Plain Zoning
I - Flood Plain Insurance
FRS - Floodwater Retarding Structures

Alternative No. 1-4 is the same as Alternative No. 1-3 with the addition of flood plain management including zoning for those uses best adapted to flooding. Agricultural use of the flood plain would be controlled. State law prohibits restriction of agricultural use of land. Flood insurance would be made available to all communities. This alternative would require additional studies for evaluation.

Alternative No. 1-5 consists of accelerated land treatment and channel work to achieve the flood reduction benefits provided by the planned project. Channel work would be enlargement and realignment, or confinement by dikes, of approximately 4 miles of intermittent stream and 13 miles of perennial stream. While flood reduction benefits as large as the planned project could be obtained, flooding would be increased downstream. The achievement of damage reduction, comparable to the planned project, through channel enlargement and realignment or diking would require a destruction of riparian and aquatic stream habitat.

Alternative No. 1-6 consists of 16 low-head dams, on the mainstem channel for groundwater recharge annual clean out of the pools created by the dams, and accelerated conservation land treatment. The pools would inundate 4 miles of intermittent stream and 10 miles of perennial stream. In 7 years resource management systems would be installed on 37,620 acres of agricultural land. The average annual upland soil loss would be reduced from 5.6 to 3.6 tons per acre. The average annual sediment deposition in existing ponds would be reduced 25 percent and the average annual sediment yield to the watershed outlet would be reduced from 31,000 tons to 19,000 tons. The project would result in 50 acre feet of additional ground water and increased evapotranspiration of 10 acre feet annually. Average annual discharge would be reduced 50 acre feet. The project would result in $7,800 average annual increase in flood damages on 14,853 acres of flood plain. Average annual costs of clean out and maintenance of the pools and maintenance of the dams would be $43,200. This installation cost of the project would be $2,229,600.

Alternative No. 1-7 is the planned project plus low-head dams on the mainstem channel for additional groundwater recharge. The pools created by the low-head dams would inundate an additional 4 miles of intermittent stream and 13 miles of perennial stream. This alternative would not reduce flood damages as much as the planned project. This alternative would result in 2,900 acre feet of additional ground-

water and increased evapotranspiration of 1,000 acre feet annually. Average annual discharge of Wet Walnut Creek at Albert would be reduced 3,600 acre feet. Average annual costs of cleanout and maintenance of the pools and maintenance of the dams would be $17,700.

All viable alternatives were evaluated in terms of their effects on watershed problems and planning objectives. Alternatives which provided the maximum reduction in average annual flood damages for the watershed were considered most desirable for the following reasons:

The flood plain is already extensively used, mostly for agricultural enterprise. Any reduction in present or future agricultural use of the flood plain would be undesirable as an alternative because of the importance of agricultural production to the area's economy.

Additionally, sponsors felt that the reductions in adverse effects (See Effects Section) that would be achieved by eliminating recreational use were not sufficient to justify the loss of benefits.

After consideration of all viable alternatives that could reduce or eliminate adverse project effects, the proposed project, which includes conservation land treatment, 2 multipurpose structures, and all economically justifibale floodwater retarding structures was selected.

## WORKS OF IMPROVEMENT TO BE INSTALLED

### Land Treatment Measures

Resource management is essential to a sound watershed protection and flood prevention program. Farmers and ranchers, in cooperation with the conservation districts, will develop conservation plans to achieve proper land use and conservation.

Adequate land treatment will be implemented on 28,800 acres of cropland, 8,600 acres of rangeland, and 220 acres of forest land. Conservation agreements must be obtained from operators of at least 50 percent of the land in drainage areas above reservoirs before construction of the structure is started. Additionally 75 percent of the effective land treatment measures must be applied to sediment source areas which, if uncontrolled, would require a material increase in

the cost of construction, operation, or maintenance of the structural measure. Provisions for installation of these measures before or concurrent with construction must be made in each project agreement. The resource management systems will include all practices that are needed for desired and compatible use of a particular land area. Land use conversions needed to establish proper conservation of the watershed resources include 850 acres of cropland to: hayland, 350 acres; rangeland, 300 acres; wildlife and recreational land, 170 acres; forest land, 30 acres; and 260 acres of rangeland to wildlife and recreation land.

Alternative conservation practices for cropland resource management systems include:

Conservation Cropping System: Using needed cultural and management measures for crops. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without these crops.

Stubble Mulching: Managing plant residue on a year-round basis in which harvesting, tilling, planting, and cultivating are performed to keep protective amounts of vegetation on the soil surface.

Minimum Tillage: Limitation of cultivation to that essential to crop production and prevention of soil loss.

Gradient Terraces: A system of earth embankments, ridges, and channels constructed along a slope at a suitable spacing and with an acceptable grade.

Diversion: A channel with a supporting ridge on the lower side constructed across a slope. Diversions are constructed to divert water from areas where it is in excess to sites where it can be used or disposed of safely.

Contour Farming: Cultivation of sloping land at right angles to the slope. This includes following established grades of terraces, diversions, or contour strips.

Grassed Waterway or Outlet: A natural or constructed passageway for water with vegetation established that is suitable for safe disposal of runoff from a field, diversion, terrace, or other structure.

Drainage: Disposal of excess water in a field by grading to reshape the land surface or by construction of a graded ditch.

Artificial Groundwater Recharge System: A conservation practice system for temporary surface storage of excess runoff to be infiltrated into the soil and percolated to the groundwater table.

Level Terrace: An earth embankment or a ridge and channel constructed across the slope at a suitable spacing with no grade.

Rangeland is used for grazing livestock and big game animals. The natural plant community is dominated by grasses, grass-like plants, forbs, legumes, and shrubs. Primary practices among alternatives for rangeland are:

Proper Grazing Use: Grazing at an intensity which will maintain enough cover to protect the soil and maintain or improve the quality and quantity of desirable vegetation. This can be accomplished by stocking at rates compatible with forage production where summer-long grazing is practical or by rotating grazing use between two or more pastures. Cropland forage to produce seasonal pasture, hay, or silage can be planned to supplement rangeland pastures.

Planned Grazing Systems: A system in which two or more grazing units are alternately rested from grazing in a planned sequence over a period of years. The rest period may be throughout the year or during part of the growing season of the desirable plants. Many pastures in the watershed contain sufficient amounts of desirable plants to recover rapidly through periodic deferments.

Brush Management: Manipulation of stands of brush by mechanical, chemical, or biological means, or by controlled burning. This included reducing excess brush and weeds to restore natural plant community balance and manipulation of brush stands through selective and patterned control methods to meet specific needs of the land and objectives of the land user.

Range Seeding: Establishing adapted plants by seeding on rangeland.

Pond: A water source for livestock made by constructing a dam or embankment or by excavating a pit.

Detention Dam: A dam or embankment which temporarily detains floodwater to regulate the rate of flow in a watercourse.

Woodland is used primarily to produce adapted woody plants, to provide cover to protect fields and farmsteads from inclement weather, and to supply watershed protection, wildlife habitat, and landscape diversity. For optimum maintenance or improvement of hydrologic conditions, woodland areas must support vigorous, full-stocked stands of trees with undisturbed ground cover. Benefits, from woodland management will be sustained by realizing the maximum economic returns consistent with site capabilities. To obtain these objectives, the following will be employed:

Woodland Improvement: This may include harvesting mature trees, removing poor quality or less desirable trees, and pruning the managed species.

Windbreak and Shelterbelt Planting and Renovation: Planting tree and shrub seedlings to establish new or renovate existing shelterbelts and windbreaks. Renovation may also include the removal or pruning of existing plants or the adoption of improved management practices.

Hedgerow Replacement or Renovation: Hedge seedlings may be planted to establish permanent field borders and add to wildlife habitat and landscape beautification.

Grazing Control: Grazing can damage young trees and cause soil erosion and compaction. All new plantings and cultural operations should be protected from grazing livestock. Some good quality young native timber also need protective fencing.

Tree and Shrub Plantings: Special shelterbelt plantings are planned at each flood control structure to break up summer winds and thereby reduce evaporation. These plantings will be planned to maximize their value for wildlife habitat, recreation shelter and site beautification. Plantings in other areas will serve similar purposes.

An educational program is planned to inform rural residents of the economic and wildlife benefits that can be gained from excluding livestock from woodlands and shelterbelts.

A forestry work plan was developed for the watershed by the Kansas State and Extension Forester, in cooperation with the U.S. Department of Agriculture, Forest Service.18/ Forestry technical assistance provided through the existing Cooperative Forest Management Program and the P.L. 566 program will adequately serve the needs of the watershed woodlands throughout the life of the project.

Although the watershed area is protected by rural fire districts, new districts need to be organized in response to additional, documented fire protection needs. Fire prevention education programs will be developed. Technical assistance for fire control measures will be provided by the Kansas State and Extension Forester.

The cost of improved fire control equipment and facilities is to be borne by rural fire districts. Technical fire control assistance will be provided from going programs.

As part of the land treatment measures to be installed, the watershed district, in cooperation with the conservation districts, will work with landowners to install approximately 10 detention dams. These dams will control drainage areas ranging in size from 0.45 to 5.90 square miles, for a total of 16.67 square miles, or 7.3 percent of the watershed. These dams will provide detention of runoff averaging 2 inches per square mile. The total estimated flood storage for the 10 detention dams is 1,780 acre feet. Sediment pools will store 380 acre feet.

Watershed directors and conservation district supervisors are furnishing part-time technical assistance to accelerate the installation of soil and water conservation treatment. Provisions have been made for personal contact with landowners and operators to urge them to establish conservation practices on their farms. During this contact, people will be informed about the watershed program and its progress. Underlying these efforts is the importance of landowner-operator understanding that these treatment measures not only benefit them individually but also are necessary prior to building floodwater retarding structures in the watershed.

Nonstructural Measures

Data will be provided to the communities of Heizer, Albert and Timken during detailed flood insurance or special flood hazard studies to avoid increased future urban and rural residence flood damages. Such precautions as selective location, elevating, or flood proofing will prevent future

damages to rural and urban facilities. Flood warning systems are effective for reduction of damages from floods generated by storms in the middle and upper portions of the Wet Walnut Basin. These floods take from one to several days of travel time to reach the Albert vicinity.

Structural Measures

A system of seven floodwater retarding structures and two multipurpose structures with recreational facilities will be installed at locations shown on the project map.

Floodwater retarding Structure No. 2 will be installed with a roadway across the top of the dam.

All structures will be earth dams with vegetated emergency spillways provided to release runoff exceeding reservoir storage capacity safely past the dam. All foundations are classified as yielding and consist mostly of silty clay. Emergency spillways have been planned so that their chance of operation in any one year is 2 percent or less. A cross section of a typical structure is shown on Figure 1 (page 79).

At all sites the predominant emergency spillway material to be excavated is silty clay. The remaining material to be excavated will be shale and limestone.

The predominant borrow material at all sites will be silty clay. The intended borrow area for all sites is the sediment pool and emergency spillway excavation. Clearing will be necessary in the borrow areas; however, any opportunity to retain trees and brush will be given special consideration.

All structures will have drop inlet type principal spillways with single-stage inlets near the elevation of the estimated 100 year accumulation of sediment. Principal spillways will be reinforced concrete, or a material of comparable quality and strength. Average uncontrolled release rates, of 3.5 cubic feet per second per square mile of drainage area above the structures will not exceed downstream channel capacities.

Natural streamflow is to be passed through the dams to meet downstream water rights as provided by the Kansas Water Appropriation Act. Principal spillways will include 8 inch

minimum diameter drawdown pipes with control valves to permit low flow releases regardless of reservoir storage elevation.

The floodwater retarding structures will have a total of 8,671 acre feet of floodwater storage. Retarding storage capacity will vary from 3.0 to 3.6 inches of runoff from the drainage area. Drainage area controlled by the structures will range from 1.71 to 13.40 square miles. A total of 22.9 percent of the drainage area in the watershed will be controlled. Sediment storage will be provided for the expected 100 year accumulation of 1,037 acre feet. Sediment storage volumes range from 0.32 to 0.46 inch from the drainage areas.

All structural measures are designed for 100 year life.

Multipurpose Structure No. 1 is planned to store 2,201 acre feet for floodwater retarding storage, 321 acre feet for recreational water and 220 acre feet for sediment. The recreational pool will have a full pool surface area of 80 acres 56 percent of the time. A 54 acre pool will be available for recreational use 80 percent of the time. Twenty-six acres below the full pool line will be exposed around shoreline 20 percent of the time. The pool will have a maximum initial depth of 26 feet and an average initial depth of 6.9 feet. The average depth at the end of 100 years is estimated to be 4 feet. The estimated fill time for the recreational pool after installation is 2 years.

Multipurpose Structure No. 4 is planned to store 1,974 acre feet for floodwater retarding storage, 221 acre feet for recreational water, and 244 acre feet for sediment. The recreational pool will have a full pool surface area of 102 acres 21 percent of the time. A 30 acre pool will be available for recreational use 80 percent of the time. Seventy-two acres below the full pool line will be exposed around shoreline 20 percent of the time. The pool will have a maximum initial depth of 25 feet and an average initial depth of 4.6 feet. The average depth at the end of 100 years is estimated to be 2.2 feet. The estimated fill time for the recreational pool after installation is 2 years.

Five hundred and twenty-one acres of land will be purchased in association with multipurpose Structure No. 1. This land includes 361 acres for recreational use and floodwater detention, and 160 acres to insure full use of the recreational facilities. Flowage easements will be obtained on an additional 29 acres.

Five hundred and forty-six acres of land will be purchased in association with multipurpose Structure No. 4. This land includes 342 acres for recreational use and floodwater detention, and 204 additional acres to insure full use of the recreational facilities. Flowage easements will be obtained on an additional 35 acres.

All borrow areas for the multipurpose structures will be located on purchased land.

Sponsors will provide public access to recreational facilities at the multipurpose reservoirs. All recreational facilities will be installed, operated, and maintained to meet or exceed the requirements of state and local public health agencies. In addition, HEW standards will be used as guidelines.30/ Facilities will be designed and constructed to be usable by the physically handicapped.

Sediment pools in all the floodwater retarding structures will have some potential for limited recreational use. Access to these structure sites will be controlled by landowners. Access by the general public will be prohibited unless or until adequate sanitary facilities are provided to meet State and local health requirements. The watershed district will notify the State Department of Health and Environment if adequate sanitary facilities are not provided.

If the multipurpose reservoirs are eventually officially designated a "body contact area" by the Kansas State Department of Health, the Kansas Forestry, Fish and Game Commission will be responsible for regular monitoring of water quality in the lake in accordance with the state code for Class A waters. This requirement does not prohibit use of the lake for body contact water sports prior to such designation. Facilities for full use of the multipurpose structures will be installed during the project period as described in Table 2B. These include fencing, signs, access roads, parking, drinking water, picnic facilities, sanitary facilities, and facilities for boating. Random or primitive camping areas will be available.

A pipeline involved with Structure No. 2 and a powerline involved with Structure No. 9 will be moved or modified to allow installation. See Table 2 for estimated costs. An easement will be required on a railroad right-of-way at Structure No. 4.

Record search and field examination confirm abandoned gas or oil wells located in the reservoir areas to be adequately plugged. No producing gas or oil wells will be affected by structural measures.

An outdoor educational laboratory is proposed at Structure No. 3 by the watershed district in cooperation with 2 school districts and a junior college. It is estimated that almost 6,000 students will be served annually. Nature trails are planned to provide maximum use of existing vegetation and geological formations. The Kansas State and Extension Forester will assist with additional plantings to enhance the educational value of the area. This development will also provide an environment favorable to wildlife. Windbreaks, grass borders, controlled mowing, maintenance of den and nut trees, and construction of brush piles will help increase wildlife populations. Classes will be developed to help students learn proper use and conservation of natural resources. Costs for the outdoor educational laboratories are nonproject costs to be paid by the school districts and junior college.

As a result of the acquisition of land for the two multipurpose structures, it is estimated that seven persons on two farm operations associated with Structure No. 1 and three persons on one farm operation associated with Structure No. 4 will be eligible for relocation payments. Relocation payments of $15,000 and $5,000 for Structure Nos. 1 and 4 respectively are included in the estimated structural cost distribution as shown in Table 2.

Specific measures to offset wildlife losses and enhance habitat have been recommended for each structure site. Maps and descriptions of these measures are included in a report by the U.S. Fish and Wildlife Service.13/

Compensating measures have been adopted as design features for each structure. The dams and spillways of the seven floodwater retarding structures will be fenced and seeded to a grass-legume mixture suitable for wildlife. The fee title areas of the multipurpose structures will be fenced and the dams and spillways seeded to a grass-legume mixture suitable for wildlife. Specific odd areas adjacent to Structure Nos. 6, 7, and 8 as designated in the Fish and WildlifezService Report are to be within the permanently fenced and seeded area. Tree and shrub plantings are to be made in the designated areas for Structure Nos. 6 and 8. The location of tree and shrub plantings for multipurpose Structure No. 1 will be determined at the time of installation. Mature trees will be preserved where possible.

Enhancement measures recommended in the Fish and Wildlife Service report for installation at the floodwater retarding structures include: additional odd areas and tree and shrub plantings within the permanently fenced area; seeding cropland within a 1 foot vertical elevation of the sediment pool to switchgrass; leaving as much woody vegetation within the sediment pools as possible; constructing brush piles suitable for wildlife using trees cleared for construction; and planting borrow areas within sediment pools to a quick cover crop. None of the enchancement measures have been adopted as a part of this plan.

The need for water and air pollution abatement during construction will be determined on a site-by-site basis. Abatement measures may include dry stream crossings, temporary vegetative establishment, watering for dust control, controlled burning, and sediment control basins.

The Soil Conservation Service will in consultation with the State Historic Preservation Officer maintain close communication with the State Archeologist during project construction so that any finds may be investigated to determine the need for emergency salvage. The National Park Service will also be notified of any discoveries. If necessary, the Secretary of the Interior will be asked to determine the site's eligibility for inclusion on the National Register. The Advisory Council on Historic Preservation will be requested to comment on any site affected by project activities which have the qualities to make it eligible for inclusion in the National Register of Historic Places. This is in accordance with Section 106 of the National Historic Preservation Act, PL-89-665, 16 USC 470(f). Since this is a federally assisted local project, there will be no change in the existing responsibilities of any federal agency under Executive Order 11593 with respect to archeological and historical resources.

## EXPLANATION OF INSTALLATION COSTS

Needed land treatment measures and their estimated costs are shown in Table 1. The estimated total planning and installation cost for land treatment is $1,836,700. Public Law 566 funds will provide $117,500 of this total for technical assistance to accelerate the current program. Other sources will provide the remaining $1,719,200 for installing these measures. Land treatment installation costs include 10 detention dams. All land treatment cost estimates are based on present costs under current programs.

The watershed district (to be reimbursed by Rush County) will pay for modifications to Structure No. 2 to accommodate

a roadway across the dam. The district will pay 13.5 percent of the construction and engineering costs estimated at $13,300 and $1,900 respectively. The costs are shown in Table 2 as non-project costs. The Service and the district will enter into an agreement on payment of the roadway construction and engineering cost prior to initiating the work. Planned structure modifications are widening the top of the dam to 24 feet, additional principal spillway length as necessary to accommodate the added top width, and the earthwork as needed to shape the roadway through the emergency spillway. Items such as guardrail or roadway surfacing are not included.

Structural measures and their estimated costs are also shown in Table 1. These costs are separated by individual structure sites in Table 2. The total estimated cost for all structural measures is $2,056,300. The following discussion of structural measures costs deal first with major elements listed in Table 1 (construction, engineering services, relocation payments, project administration, and land rights). Following next is an explanation of estimated structural cost distributions found in Table 2.

Construction cost estimates are based on topographic survey data and unit costs of similar work on other projects. A contingency allowance of 12 percent was used; however, no unusual construction problems are anticipated.

Engineering services include all direct and related costs of surveys, geologic site investigations, soil mechanics, structure design, construction plans, and specifications.

Relocation payments are made to those landowners and farm operators who are displaced from their farm operation. These costs include moving and expenses of searching for a replacement farm location or payments for direct loss of personal property if the farm operation is not relocated. The estimated total relocation payments are $20,000. Public Law 566 funds will pay 46.0 percent or $9,200 and other sources will pay 54.0 percent or $10,800. The cost-sharing percentages are based on the ratio of P.L. 566 funds and other funds to the total project costs, not including relocation payments. The sponsors and the Service will be involved in administrative functions in connection with relocation payments. Each will bear the costs they incur.

Project administration costs are P.L. 566 and other administrative costs associated with installation of structural measures. These costs include contract administration, review of engineering plans prepared by others, and necessary inspection service during construction to see that structural measures are installed in accordance with plans and specifications. Project administration costs to the district also includes relocation assistance advisory services. These services shall provide (1) measures or facilities necessary to determine relocation assistance needs, (2) information regarding replacement property, (3) informational brochures, (4) assurance of replacement dwellings, and (5) assistance in getting established. In addition to relocation assistance advisory services, the sponsors and the Service will be involved in administrative functions in connection with relocation payments. The sponsors and the Service will each bear the costs they incur. These shall include costs for: (1) serving notice of displacement, (2) providing application forms, (3) assisting in filing applications, (4) hearing and resolving grievances, and (5) making relocation payments. The Service will assist the sponsors in carrying out these administrative functions.

All land values were determined by the Wet Walnut Creek Watershed Joint District Board of Directors and agreed to by the Soil Conservation Service where the watershed district is to pay the entire cost. Land rights cost estimates are based on current land values which vary from $200 per acre for grassland to $750 per acre for leveled and irrigated cropland. The Service and the sponsors determined the estimated land rights costs for the multipurpose structures. Land rights cost estimates also include appraisal fees, legal fees, and all necessary easements. Land rights cost estimates may not coincide with actual out-of-pocket costs to the local sponsoring organization because some easements may be donated. Land cost estimates for the recreational sites are based on $200 per acre. Some additional local costs are required in modifying roads and utilities.

Construction and engineering cost for the multipurpose sites, excluding recreational facilities, will be allocated on the basis of the "use of facilities" method. Allocations computed in this manner are: flood prevention, 88.3 percent, and public recreation, 11.7 percent for multipurpose structure No. 1; and flood prevention, 90.9 percent, and public recreation, 9.1 percent for multipurpose structure No. 4. Construction costs will be shared as follows:

Multipurpose Structure No. 1

| Item | Sponsoring Local Organization % | Sponsoring Local Organization Cost | P.L. 566 % | P.L. 566 Cost | Total % | Total Cost |
|---|---|---|---|---|---|---|
| Public Recreation | 50.0 | 13,300 | 50.0 | 13,300 | 100 | 26,600 |
| Flood Prevention | 0 | 0 | 100.0 | 200,400 | 100 | 200,400 |
| Total | 5.85 | 13,300 | 94.15 | 213,700 | 100 | 227,000 |

Multipurpose Structure No. 4

| Item | Sponsoring Local Organization % | Sponsoring Local Organization Cost | P.L. 566 % | P.L. 566 Cost | Total % | Total Cost |
|---|---|---|---|---|---|---|
| Public Recreation | 50.0 | 9,200 | 50.0 | 9,200 | 100 | 18,400 |
| Flood Prevention | 0 | 0 | 100.0 | 183,300 | 100 | 183,300 |
| Total | 4.55 | 9,200 | 95.45 | 192,500 | 100 | 201,700 |

The engineering costs for the multipurpose structures are estimated at $69,200. All of these costs are paid by P.L. 566 except for $6,400 of the $8,400 required for the recreational facilities.

Land rights for the multipurpose structures and the recreational facilities and development are to be acquired on 1,096 acres at an estimated cost of $228,700. These costs will be shared as follows:

| Item | Sponsoring Local Organization % | Sponsoring Local Organization Cost | P.L. 566 % | P.L. 566 Cost | Total % | Total Cost |
|---|---|---|---|---|---|---|
| Dam and Reservoir fee title 703 acres | 50.0 | 70,300 | 50.0 | 70,300 | 100 | 140,600 |
| Recreational Area 364 acres | 50.0 | 36,400 | 50.0 | 36,400 | 100 | 72,800 |
| Surveys, Legal Fees, etc. (includes easement on 64 acres) | 100.0 | 15,300 | 0 | 0 | 100 | 15,300 |
| Total | | 122,000 | | 106,700 | | 228,700 |

Costs paid with P.L. 566 funds for the seven floodwater retarding structures include all the construction and engineering services costs, except non-project costs for these purposes. Part of the project administration costs will also be paid from P.L. 566 funds. The district will pay the land rights costs including utility modification costs as shown on Table 2.

The total project administration cost is estimated to be $463,200. Public Law 566 bears $391,900 of this cost and other funds will pay the remaining $71,300. The service and the sponsors will each bear the costs they incur.

The total estimated installation cost of the seven floodwater retarding structures and the 2 multipurpose structures is $1,593,100. These costs, in relation to purpose and cost sharing, are shown in Table 2A.

Estimated total P.L. 566 costs and other obligations by fiscal years during the project installation period are as follows:

Land Treatment

| Fiscal Year | P.L. 566 Costs | Other Costs | Total |
|---|---|---|---|
| First | 23,500 | 343,800 | 367,300 |
| Second | 23,500 | 343,800 | 367,300 |
| Third | 23,500 | 343,800 | 367,300 |
| Fourth | 23,500 | 343,800 | 367,300 |
| Fifth | 17,600 | 257,800 | 257,400 |
| Sixth | 5,900 | 86,200 | 92,100 |
| Seventh | -- | -- | -- |
| Total | 117,500 | 1,719,200 | 1,836,700 |

Structural Measures

| Fiscal Year | P. L. 566 Costs | Other Costs | Total |
|---|---|---|---|
| First | 139,200 | 78,100 | 217,300 |
| Second | 281,500 | 75,500 | 357,000 |
| Third | 121,100 | 44,200 | 165,300 |
| Fourth | 380,900 | 66,300 | 447,200 |
| Fifth | 434,100 | 76,900 | 511,000 |
| Sixth | 259,100 | 30,700 | 289,800 |
| Seventh | 57,900 | 10,800 | 68,700 |
| Total | 1,673,800 | 382,500 | 2,056,300 |

## EFFECTS OF WORKS OF IMPROVEMENT

### Flood Prevention, Erosion, and Sediment

The planned project will reduce the 100 year flood near Heizer from 13.2 csm to 6.4 csm and would eliminate flood damage up to the 3 year flood. The effect on the area flooded by the 100 year frequency storm is shown in the following table.

| Reach | Area Inundated 100 Year Frequency Storm Without Project (AC) | With Project (AC) |
|---|---|---|
| I | 3,904 | 2,539 |
| II | 3,524 | 1,609 |
| III | 7,424 | 4,565 |
| Total | 14,853 | 8,713 |

Average annual flood damages will be reduced by 49 percent in this watershed. Thirteen percent would be from land treatment applied in the basin, 4 percent would be from structural measures in this watershed, and 32 percent from structural measures in upstream watershed. The watershed protection program would benefit all or parts of 51 farms on the evaluated flood plain on the project. In addition, the project will benefit directly or indirectly all of the 5,914 inhabitants of the watershed (including 35 farms with land on tributory flood plains having significant damage only with floods approaching or exceeding the 100 year frequency storm) and 18,850 inhabitants associated with 15,300 flood plain acres downstream.

The proposed project would have reduced the damage from the Setpember 1959 flood by 33 percent. The total area flooded would have been reduced from 14,570 acres to 5,666 acres.

The effects of structural works of improvement on a flood equivalent to the 1959 flood is shown in the following table:

| | 1959 FLOOD | | 100-YEAR FREQUENCY Elevation Related to 1959 Flood | |
|---|---|---|---|---|
| | Without Project | With Project | Without Project (ft.) | With Project (ft.) |
| Heizer | | | +.2 | -.6 |
| Water Depth (Number of Locations) | | | | |
| Below first floor - | | | | |
| with basement | 3 | 4 | | |
| without basement | 2 | 3 | | |
| .0 to .5' above first floor - | | | | |
| with basement | 3 | - | | |
| without basement | 1 | - | | |
| .5 to 1.0' above first floor - | | | | |
| with basement | 1 | - | | |
| without basement | 3 | - | | |
| Albert | | | +.3 | -.6 |
| Water Depth (Number of Locations) | | | | |
| Below first floor - | | | | |
| with basement | 9 | 9 | | |
| without basement | 57 | 54 | | |
| 0 to .9' above first floor - | | | | |
| with basement | 2 | - | | |
| without basement | 20 | 2 | | |
| .9 to 2.5' above first floor - | | | | |
| with basement | - | - | | |
| without basement | 4 | 2 | | |
| Timken | | | +.5 | +.2 |
| Water depth (Number of Locations) | | | | |
| Below first floor - | | | | |
| with basement | 6 | 8 | | |
| without basement | 17 | 18 | | |
| 0 to .5' above first floor - | | | | |
| with basement | 2 | 1 | | |
| without basement | 1 | 2 | | |
| .5 to 2.5' above first floor - | | | | |
| with basement | 3 | 2 | | |
| without basement | 3 | 1 | | |

The project will increase the level of flood protection of the planned local protection works at Great Bend. The requirements of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 will serve to regulate further development of designated flood prone areas. Subsidized flood insurance is available to residents of Albert and Timken under the Emergency Flood Insurance Program. Barton County will act for rural residents and unincorporated communities including Heizer in designated flood hazard areas.

Land use and cropping pattern on the flood plain are not expected to change greatly. Decreased flooding will allow more intensive use of 6,493 acres. The land treatment program should result in more efficient use of land and water resources and, thus, increase farm income.

Normal release of retarded floodwater will result in increased groundwater recharge. Principal spillways are planned to operate at about bank full capacity throughout the tributary and mainstem channel reaches. More than one half of flows that would normally pass a given point over a 2 to 3 day period will be detained within the channel banks for 20 to 30 days. This increase in channel flow duration will increase recharge through the channel walls.19/ Reduced flood plain inundation does not reduce the net recharge increase since a negligable amount of natural recharge takes place through flood plain soils and subsoils. One thousand seven hundred acre feet of mainstem recharge and 600 acre feet of tributary recharge will occur annually. These same works will increase evapotranspiration losses 1,100 acre feet annually.

The average annual soil loss in Subwatershed No. 1 will be reduced from 5.6 to 3.6 tons per acre. Changes in soil loss by land use will be: cropland 6.8 to 4.3 tons per acre; rangeland 1.8 to 1.4 tons per acre; woodland and miscellaneous no change. The project will reduce severe scour such as resulted from the September 1959 storms.

The combined effects of the watershed projects will reduce the total average annual sediment yield to the Arkansas River from an estimated 170,000 tons to 86,400 tons. The average annual sediment yield from this watershed to Wet Walnut Creek will be reduced by 13,400 tons. However, the average annual sediment yield from this watershed to the Arkansas River will be reduced by 12,800 tons. At Albert the combined effects of the watershed projects will lower the

average annual suspended sediment concentration from 1,200 mg/l to 1,000 mg/l. This watershed accounts for 17 percent of the reduction.

The water quality standards for Kansas streams such as Wet Walnut Creek are already being met. They will still be met following completion of the watershed project.21/ The major impact upon the quality of the water in Wet Walnut Creek and its tributaries will be a reduction in sediment load.

The other effects on the quality of streamflow will be minimal and localized, although a lack of data concerning the effects of completed watershed projects on streamflow quality prevents any detailed predictions. It is likely that some reduction will occur in organic waste and nutrient levels.

Fish and Wildlife

Base flow in perennial streams will be increased, as will the flow in all streams below structures. Prolonged releases and seepage from the reservoirs are expected to provide additions to low flows of sufficient magnitude or duration to change some stream classification: 10 miles of ephemeral stream to intermittent and 8 miles of intermittent stream to perennial. During some periods reservoir levels will be below principal spillway inlets. Natural stream flow will be passed through the dams during drought periods as required to meet downstream water rights.

Some soil erosion and air and water pollution will occur during reservoir construction. These effects will be minimized.

A reduction in mortality to species inhabitating the flood plain below structures will occur due to reduced flooding. Rather than increasing population levels, this will probably tend to stabilize populations in that area.

Seventy-two acres of cropland and 374 acres of rangeland in sediment and recreation storage pools will be lost to agricultural and terrestrial wildlife habitat use. Periodic flooding of 1,175 acres by retarding and detention pools will interrupt and reduce agricultural and wildlife uses. In addition construction of dams and spillways on 238 acres of cropland and 59 acres of rangeland will largely displace

these uses; however, revegetation will return most of the land to wildlife habitat. Four hundred and forty acres of agricultural land associated with the recreational development areas will be available for use as managed terrestrial wildlife areas.

Measures to enhance fish and wildlife habitat (fencing and seeding areas to grasses and legumes, additional tree and shrub plantings, and seeding pool areas to quick cover crops) will increase fish and wildlife habitat. Installation of land treatment measures will improve terrestrial wildlife habitat by increasing habitat diversity.

Project measures will create 446 surface acres of habitat for aquatic and migratory waterfowl. They will improve the Wet Walnut Creek stream fishery.

Impoundments will inundate 19 miles of ephemeral stream and 2 miles of perennial stream.

The proposed project will have no impact on endangered or threatened species, other than to increase the possible number of resting places available to the whooping crane, a possible transient resident in the area.15/

Recreation

Construction of the two multipurpose reservoirs will provide 1,067 acres for recreational use and is expected to draw visitors from throughout the area of influence. Fifty percent of the visitors will come from outside the watershed. While the lakes and recreational facilities will be used throughout the year, 60 percent of the recreational visits will occur between May 15 and September 15. The daily design capacity for the sites will be 295 for sightseeing, 8 for boating, 245 for fishing, 100 for picnicking, and 72 for camping. Hunting, fishing, picnicking, sightseeing, random and primitive camping, and other recreational activities will be available. An estimated 70,000 annual recreational visits are expected.

The multipurpose reservoirs will provide fishing waters during drought periods and will maintain a stable fish population for use by watershed residents during these periods.

Water quality in the multipurpose reservoirs is expected to be adequate for the intended use and to meet state water quality criteria.21/

Archeological, Historic and Scientific

Project measures will have no effect on any known historic or archeological sites. The State Historic Preservation Officer and the National Park Service will be notified immediately of any archeological sites discovered during construction.

Economic and Social

The works of improvement will have a positive effect on the area economy. Construction of the P.L. 566 structures will provide 35 man years of new employment over a 7 year period. Operation, maintenance, and replacement will provide 2 man years of employment annually. These employment opportunities will primarily benefit low and moderate income groups of the area.

There will be a positive effect on the quality of living for many watershed residents resulting from increased capital made available by reduced floodwater damages and more intensive use of property used in agricultural production. In addition, the general public, especially watershed residents, will benefit from better roads as a result of the reduced maintenance and repairs of the road system.

Relocation may adversely affect the quality of living for 10 persons on 3 farms that will be eligible for relocation assistance. It is estimated that 580 acres of these farms will be affected. None of the farmsteads and dwellings will be inundated or otherwise involved. Most of the residents are near retirement age and may elect to accept the reduction in sizes of the farms instead of relocating. Decreasing the sizes will decrease agricultural income for farm operators, an adverse effect on the quality of life for these persons.

The project offers a sound basis for rural development. Farm operations in areas where a high degree of flood protection is offered have a better change of survival. Thus a reversal in the trend of declining numbers of farms is more likely with the project.

Secondary benefits will result from transporting, processing, and marketing greater amounts of agricultural commodities produced as a result of reduced crop losses. Increased

farm incomes will mean increased consumer expenditures for farm equipment and material to local retailers and wholesalers. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation. An increase in job opportunities and the economic benefits associated with additional commercial growth activities, particularly those which service the recreational areas, will accrue to the watershed and region.

In addition to the monetary benefits, there are other substantial intangible benefits which will result from the project. These include better living conditions, a sense of economic security, and the psychological security associated with the abatement of a fear of flooding.

The recreational developments will provide public open space areas in addition to serving recreational use needs.

Sediment pools of the floodwater retarding structures and detention dams will be of some benefit to agricultural operations by providing livestock water supply.

Traffic, noise and litter around the recreational developments will increase. For nearby residents, the aesthetic value of the area will change with the addition of reservoirs and recreational facilities.

At the multipurpose structures, 108 acres around the full pool shoreline will be exposed 20 percent of the time.

Other

The following land use changes are expected to occur during the installation period of the project:

| Land Use | Present (acres) | End of Installation (acres) | Net Changes (acres) |
|---|---|---|---|
| Cropland | 111,912 | 110,359 | -1,553 |
| Rangeland | 28,681 | 28,460a/ | - 221 |
| Forestland | 910 | 940 | + 30 |
| Other | 3,789 | 5,533b/ | +1,744 |
| Total | 145,292 | 145,292 | --- |

a/ Includes 350 acres hayland
b/ Includes 1,744 acres Wildlife and Recreation

## PROJECT BENEFITS

Average annual project benefits are $301,300. Of this, $62,600 will accrue from land treatment measures and $238,700 from structural measures. Individual items are shown in Tables 5 and 6.

Average annual on project floodwater damage reduction benefits total $189,200. Benefits from reduced floodwater damage to crops and pasture will average $155,200 annually and account for 82 percent of the total floodwater damage reduction benefits. Reduced flooding will achieve benefits of $4,900 to other agricultural properties such as stored feed, fences, building, and other farm facilities. Annual average benefits of $9,000 to roads and bridges and $1,200 to railroads will result. Urban benefits will average $18,900 annually.

Benefits from reduced flood plain scour and sediment deposition will average $24,200 annually, accounting for about 10 percent of the total damage reduction benefits. Indirect average annual benefits, such as less interruption of travel for mail, school buses, and milk routes, are $20,400.

The reduction of the flood hazard will make possible annual benefits averaging $9,700 from more intensive use of land through improved crop rotations and use of fertilizer.

Multipurpose Structure Nos. 1 and 4 will produce annual recreation benefits of $140,000 from boating, fishing, sightseeing, camping, hunting, picnicking, and swimming. A value of $2.00 per recreation day is used in the evaluation.

Local net secondary benefits will average $30,300 annually. Secondary benefits from a national viewpoint were not considered in the economic evaluation.

Benefits of $37,800 will occur annually to the off-project Wet Walnut Creek flood plain area. Incidental benefits due to beneficial use of stored water will be $900. Incidental ground water recharge benefits will be $40,800. Incidental benefits were not claimed toward project justification.

## COMPARISON OF BENEFITS AND COSTS

Average annual cost of structural measures, including installation, operation, maintenance, and administration is $153,000. When the project is completely installed, the structural measures are expected to produce average annual benefits (excluding local secondary benefits) of $208,400. The benefit-cost ratio without including local secondary benefits is 1.4 to 1. With local secondary benefits of $30,300 included, the project benefit-cost ratio is 1.6 to 1.

## PROJECT INSTALLATION

Works of improvement to be installed by the district are proposed to be completed within a seven year period following the adoption of the watershed plan. This schedule is contingent upon availability of federal funds provided under authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Congress; 68 Stat. 666) as amended.

Land treatment measures will be installed by individual landowners and groups of landowners in cooperation with the Agriculture Stabilization and Conservation Service, Extension Forestry, conservation districts, and the watershed district. Technical assistance for land treatment installation will be provided by Extension Forestry, Soil Conservation Service, and the Kansas Forestry, Fish and Game Commission.

Land treatment measures include 10 detention dams that are also a part of the works of improvement in the General Plan of the watershed district.31/ Approval of the general plan has been obtained in accordance with sections 24-1213 and 24-1214 of the Kansas Watershed District Act, as amended, from the Chief Engineer of the Division of Water Resources, State Board of Agriculture. The General Plan has been adopted by Wet Walnut Creek Watershed Joint District No. 58. This process, along with requirements of the Chief Engineer, are assurances that the 10 detention dams will be installed essentially as planned. Technical assistance for the detention dams will be provided by the Service and the watershed district.

The Extension Service will assist in carrying out the educational phase of the program through the preparation of general information in cooperation with the conservation districts. The Farmers Home Administration Soil and Water Loan Program will be available to eligible farmers in the

area. The County Agricultural Stabilization and Conservation Committees will cooperate with governing bodies of the conservation districts to accelerate assistance for those practices which will accomplish the conservation objectives.

The watershed district will obtain all land rights, including legal services, needed for installation of the seven floodwater retarding structures. P.L. 566 funds will pay 50 percent, the watershed district will pay 25 percent, and the Kansas Forestry, Fish and Game Commission will pay 25 percent of the cost of land acquisition for multipurpose Structure Nos. 1 and 4 and associated recreational facilities. The watershed district will obtain 100 percent of the remaining land rights required for the multipurpose structures. The district and the Kansas Forestry, Fish and Game Commission will share equally the legal fees associated with land acquisition for the multipurpose structures. The watershed district has the power of eminent domain to obtain land rights for public improvements and has agreed to use such authority when needed.

The watershed district will make arrangements for abandonment, moving, or modification of roads, pipelines, communication lines, or other public utilities.

Land rights will be secured in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

The watershed district, as a part of their project administration, will provide written notice, application forms, and advisory services to each displaced person or farm operation; assist in filing applications, review and take action on applications for relocation assistance and displacement grievances; and make relocation payments. The Service will assist the district in carying out its responsibility.

Decent, safe, and sanitary replacement housing, if needed, will be made available prior to the construction of measures causing such displacements. All displaced persons will be given at least 90 days advance notice to vacate.

Engineering for the seven floodwater retarding structures, (except that portion for roadway design at Structure No. 2) and the two multipurpose structures will be provided by the Service. Engineering for recreational facilities will be

provided in part by the Kansas Forestry, Fish and Game Commission through its regularly employed staff and in part, by the Service in the form of on-site planning and standard designs. Technical assistance will be provided by the Kansas Forestry, Fish and Game Commission for the installation of wildlife measures.

The watershed district will contract for construction of the seven floodwater retarding structures and the two multipurpose structures. Recreational facilities will be installed by the Kansas Forestry, Fish and Game Commission with materials furnished by the Service.

Construction inspection of the seven floodwater retarding structures and the two multipurpose structures will be provided by the Service. Sponsors will make contributions toward construction inspection in accordance with their needs. The Service and the Kansas Forestry, Fish and Game Commission will share the construction inspection of the recreational facilities as needed.

The watershed district will provide 13.5 percent of the construction and engineering costs of floodwater retarding Structure No. 2 for providing the necessary modification to accommodate a roadway across the dam.

Construction can be started when necessary land treatment has been completed, necessary land rights have been obtained, P.L. 566 funds are available, and sponsoring organizations have complied with state laws relating to approval of construction plans.

Kansas Forestry, Fish and Game Commission participation in sponsorship of the multipurpose reservoirs is contingent upon funding approval by the State legislature.

## FINANCING PROJECT INSTALLATION

Land treatment measures will be financed by landowners and operators with partial cost sharing through the watershed district and/or state and federal programs in effect at the time of installation. Technical assistance will be provided by the Service using P.L. 46 funds and supplemented by accelerated asisstance using P.L. 566 funds. Installation costs of forestry land treatment and fire control measures will be borne by individual landowners, rural fire districts, and other federal programs. The cost of accelerated technical

forestry assistance will be borne by P.L. 566 and the Kansas State and Extension Forester. Technical assistance for the fire control measures will be financed by the Kansas State and Extension Forester through the Fire Control Program.

Wet Walnut Creek Watershed Joint District No. 58 and the Kansas Forestry, Fish and Game Commission have the necessary authority and power to finance and carry out watershed improvements. These powers include the right to accept contributions, levy taxes, make assessments against land specially benefited, issue bonds, and exercise the right of eminent domain.

Expenses of organizing the watershed district have been paid and current general expenses are being met by an annual ad valorem tax levy.

All local costs to be financed by the sponsors will be paid from funds currently on hand and budgeted for the purpose, funds that will be collected through taxes before construction takes place, or through the issuance of general obligation bonds.

Relocation assistance advisory services costs will be financed by the watershed district through a general tax levy.

P.L. 566 funds for construction and land rights will be provided to the local sponsoring organizations through project agreements executed with the Soil Conservation Service.

Prior to entering into agreements that obligate funds to the Service, the Wet Walnut Creek Watershed Joint District No. 58 and the Kansas Forestry, Fish and Game Commission, will have a financial management system for control, accountability, and disclosure of P.L. 566 funds received, and for control and accountability for property and other assets purchased with P.L. 566 funds.

Program income earned during the grant period will be reported on the sponsor's request for advance or reimbursement from the Service.

Federal technical assistance, engineering services, project administration, and funds for construction are contingent upon appropriations for these purposes.

## PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators of farms on which the measures are installed under agreements with the conservation district. Conservation district representatives will make periodic inspections of land treatment measures to encourage landowners to perform needed maintenance.

The watershed district is responsible for operation and maintenance of the 10 detention dams. The district will enter into agreements with the landowners who will perform maintenance as needed.

Technical assistance to landowners and rural fire districts for operating and maintaining forestry and fire control measures beyond the installation period will be provided by the Kansas State and Extension Forester in cooperation with the Forest Service under going programs.

Agreements providing for operation and maintenance of structural measures and recreational facilities will be executed by the local sponsoring organizations before federal construction funds are made available.

The seven floodwater retarding structures and the dams for the two multipurpose structures will be operated and maintained by the watershed district. The estimated average annual costs are $3,600. Maintenance will be accomplished through hired or contributed labor and equipment, and funds will be obtained from an annual tax levy.

Recreational facilities and fish and wildlife habitat measures for the two multipurpose reservoirs will be operated, maintained, and replaced by the Kansas Forestry, Fish and Game Commission. The estimated annual cost is $23,200, of which $2,200 is for recreational facilities replacement. Useful life will vary for recreation facilities, but an average period of 20 years has been used to compute replacement costs. Funds will be obtained from Kansas Forestry, Fish and Game Commission revenues.

The Wet Walnut Creek Watershed District will assume the responsibility for passing natural streamflow and managing low flow releases from the seven floodwater retarding structures. Making releases to pass natural streamflow through the two multipurpose reservoirs will be the responsibility of the Kansas Forestry, Fish and Game Commission.

The recreational pools for the multipurpose structures are normally expected to be operated between elevations 1,973.0 and 1,976.0 for Structure No. 1 and elevations 1,961.2 and 1,967.2 for Structure No. 4.

A vegetative measure (associated with structural measures) establishment period is granted. During this period the State Conservationist may approve P.L. 566 cost sharing for additional work that is required to obtain adequate vegetative cover. This period is to terminate when adequate vegetative cover is obtained or 2 growing seasons have elapsed after initial installation of vegetative work, whichever occurs first. Operation and maintenance responsibility rests with the sponsors during the establishment period, as it does during the remainder of the project life.

Maintenance work for structural measures will be carried out when needed. Kinds of maintenance expected rather frequently are repairs to fences, clearing of debris, etc. Repairs to major construction items such as dams and spillways are expected very infrequently. Technical assistance available through the Soil Conservation Service will be utilized.

Prescribed tree and shrub plantings will be maintained at a 75 percent survival rate for the first 5 years and thereafter managed to allow for desirable natural growth and reproduction during the life of the project. Mowing, haying, burning, and livestock grazing will be permitted only when deemed compatible with wildlife uses.

All structural measures will be inspected annually, after unusually severe storms and after any other unusual condition that might adversely affect their operation, maintenance, or safety. The Soil Conservation Service and local representatives jointly responsible for operation and maintenance will make annual inspections for a three year period following completion of construction. Thereafter, annual inspections will be made for the life of the structures by the sponsors.

Items of inspection will include, but not be limited to: the principal spillway and its appurtenances, emergency spillway, earth fill, vegetative cover of the earth fill and emergency spillway, fences installed as part of the structural measures, wildlife measures, and recreational facilities. Records of inspection will be maintained by the watershed district. Provisions will be made for access to inspect the structures at any time.

Sediment and beneficial use pools will be checked regularly during spring and summer months and measures taken to control mosquito breeding.

Where public access for recreation is permitted at any site, the sponsoring local organizations will require or provide sanitary facilities necessary to meet State Department of Health and Environment Standards.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with P.L. 566 financial assistance.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Wet Walnut Creek Subwatershed No. 1, Kansas

| Installation Cost Item | Unit | Number Non-Fed. Land | Estimated Cost Dollars[a] P.L. 566 Funds Non-Federal Land SCS[c] | FS[c] | Total | Other Non-Federal Land SCS[c] | FS[c] | Total | Total |
|---|---|---|---|---|---|---|---|---|---|
| LAND TREATMENT | | | | | | | | | |
| Land Areas[b] | | | | | | | | | |
| Cropland | Acres to be treated | 28,800 | | | | 1,288,900 | | 1,288,900 | 1,288,900 |
| Rangeland | | 8,600 | | | | 346,400 | | 346,400 | 346,400 |
| Forestland | | 220 | | | | | 6,900 | 6,900 | 6,900 |
| Individual Practices such as - | | | | | | | | | |
| Fire control | | 29,000 | | | | | 5,000[d] | 5,000 | 5,000 |
| Technical Assistance | | | 108,800 | 8,700 | 117,500 | 66,700 | 5,300 | 72,000 | 189,500 |
| TOTAL LAND TREATMENT | | | 108,800 | 8,700 | 117,500 | 1,702,000 | 17,200 | 1,719,200 | 1,836,700 |
| STRUCTURAL MEASURES | | | | | | | | | |
| Construction | | | | | | | | | |
| Floodwater Retarding Structures | No. | 7 | 573,600 | | 573,600 | | | | 573,600 |
| Multipurpose Structures | No. | 2 | 406,200 | | 406,200 | 22,500 | | 22,500 | 428,700 |
| Recreational Facilities | No. | 2 | 41,500 | | 41,500 | 41,500 | | 41,500 | 83,000 |
| Subtotal - Construction | | | 1,021,300 | | 1,021,300 | 64,000 | | 64,000 | 1,085,300 |
| Engineering Services | | | 144,700 | | 144,700 | 6,400 | | 6,400 | 151,100 |
| Relocation Payments | | | 9,200 | | 9,200 | 10,800 | | 10,800 | 20,000 |
| Project Administration | | | | | | | | | |
| Construction Inspection | | | 291,400 | | 291,400 | 6,000 | | 6,000 | 297,400 |
| Other | | | 100,500 | | 100,500 | 64,800 | | 64,800 | 165,300 |
| Relocation Assistance Advisory Services | | | | | | 500 | | 500 | 500 |
| Subtotal - Administration | | | 391,900 | | 391,900 | 71,300 | | 71,300 | 463,200 |
| Other Costs | | | | | | | | | |
| Land Rights | | | 106,700 | | 106,700 | 230,000 | | 230,000 | 336,700 |
| TOTAL STRUCTURAL MEASURES | | | 1,673,800 | | 1,673,800 | 382,500 | | 382,500 | 2,056,300 |
| TOTAL PROJECT | | | 1,782,600 | 8,700 | 1,791,300 | 2,084,500 | 17,200 | 2,101,700 | 3,893,000 |

a/ Price base 1974

b/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.

c/ Federal agency responsible for assisting in installation of works of improvement.

d/ Includes $3,300 contributed through going programs.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Wet Walnut Creek Subwatershed No. 1, Kansas

| Measures | Unit | Applied to Date | Total Cost (Dollars)[a/] |
|---|---|---|---|
| LAND TREATMENT | | | |
| Soil Conservation Service | | | |
| Conservation Cropping System | Ac. | 82,105 | 371,100 |
| Crop Residue Management | Ac. | 50,973 | 229,600 |
| Contour Farming | Ac. | 32,117 | 136,200 |
| Proper Grazing Use | Ac. | 21,520 | 9,000 |
| Range Seeding | Ac. | 1,249 | 29,500 |
| Grassed Waterway | Ac. | 1,053 | 292,700 |
| Diversion | Ft. | 68,343 | 9,300 |
| Terrace | Mi. | 1,147 | 485,200 |
| Farm Pond | No. | 129 | 150,700 |
| Irrigation Systems | Ac. | 4,719 | 1,111,900 |
| Grade Stabilization Structure | No. | 2 | 5,300 |
| Floodwater Retarding Structure | No. | 2 | 10,600 |
| Subtotal SCS | | | 2,841,100 |
| Forest Service | | | |
| Tree and Shrub Planting (on woodland and other land) | Ac. | 329 | 60,900 |
| Fire Control | Ac. | 19,000[b/] | 23,600 |
| Subtotal FS | | | 84,500 |
| TOTAL | | | 2,925,600 |

a/ Price base 1974
b/ These acres are included in Table 1 as needing further treatment.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Wet Walnut Creek Subwatershed No. 1, Kansas

(Dollars)[a]

| Item | Installation Cost P.L. 566 Funds | | | | | Installation Cost - Other Funds | | | | | Total Installation Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction | Engineering | Land Rights | Relocation Payments | Total P.L. 566 | Construction | Engineering | Land Rights | Relocation Payments | Total Other | |
| Floodwater Retarding Structures | | | | | | | | | | | |
| No. 2 | 85,400 | 11,900 | | | 97,300 | (13,300)[b] | (1,900)[b] | 32,000[c] | | 32,000 | 129,300 |
| No. 3 | 53,600 | 7,300 | | | 60,900 | | | 8,600 | | 8,600 | 69,500 |
| No. 5 | 63,500 | 9,200 | | | 72,700 | | | 6,500 | | 6,500 | 79,200 |
| No. 6 | 95,400 | 13,500 | | | 108,900 | | | 20,900 | | 20,900 | 129,800 |
| No. 7 | 118,200 | 16,900 | | | 135,100 | | | 20,100 | | 20,100 | 155,200 |
| No. 8 | 71,800 | 10,500 | | | 82,300 | | | 11,700 | | 11,700 | 94,000 |
| No. 9 | 85,700 | 12,400 | | | 98,100 | | | 8,200[d] | | 8,200 | 106,300 |
| Subtotal - FRS | 573,600 | 81,700 | | | 655,300 | (13,300) | (1,900) | 108,000 | | 108,000 | 763,300 |
| Multipurpose Structures | | | | | | | | | | | |
| No. 1 | 213,700 | 32,200 | 36,100 | 6,900 | 288,900 | 13,300 | | 44,600[e] | 8,100 | 66,000 | 354,900 |
| No. 4 | 192,500 | 28,800 | 34,200 | 2,300 | 257,800 | 9,200 | | 41,000[f] | 2,700 | 52,900 | 310,700 |
| Recreational Facilities | | | | | | | | | | | |
| No. 1 | 20,900 | 1,000 | 16,000 | | 37,900 | 20,900 | 3,200 | 16,000 | | 40,100 | 78,000 |
| No. 4 | 20,600 | 1,000 | 20,400 | | 42,000 | 20,600 | 3,200 | 20,400 | | 44,200 | 86,200 |
| Subtotal - MPS | 447,700 | 63,000 | 106,700 | 9,200 | 626,600 | 64,000 | 6,400 | 122,000 | 10,800 | 203,200 | 829,800 |
| Total | 1,021,300 | 144,700 | 106,700 | 9,200 | 1,281,900 | 64,000 | 6,400 | 230,000 | 10,800 | 311,200 | 1,593,100 |
| Project Administration | | | | | 391,900 | | | | | 71,300 | 463,200 |
| GRAND TOTAL | 1,021,300 | 144,700 | 106,700 | 9,200 | 1,673,800 | 64,000 | 6,400 | 230,000 | 10,800 | 382,500 | 2,056,300 |

[a] Price base 1974
[b] Nonproject cost for roadway across dam.
[c] Includes $17,100 for pipeline modification.
[d] Includes $1,000 for powerline modification.
[e] Includes $7,000 for legal fees and $1,500 for flowage easement.
[f] Includes $5,000 for legal fees and $1,800 for flowage easement.

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## TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

(Dollars)[a]

Wet Walnut Creek Subwatershed No. 1, Kansas

| Item | COST ALLOCATION | | | COST SHARING | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PURPOSE | | | P.L. 566 | | | OTHER | | |
| | Flood Prevention | Recreation | Total | Flood Prevention | Recreation | Total | Flood Prevention | Recreation | Total |
| 7 Floodwater Retarding Structures | 763,300 | | 763,300 | 655,300 | | 655,300 | 108,000 | | 108,000 |
| Multipurpose Structure No. 1 | 243,900 | 111,000 | 354,900 | 235,800 | 53,100 | 288,900 | 8,100 | 57,900 | 66,000 |
| Recreational Facilities | | 78,000 | 78,000 | | 37,900 | 37,900 | | 40,100 | 40,100 |
| Multipurpose Structure No. 4 | 216,100 | 94,600 | 310,700 | 211,800 | 46,000 | 257,800 | 4,300 | 48,600 | 52,900 |
| Recreational Facilities | | 86,200 | 86,200 | | 42,000 | 42,000 | | 44,200 | 44,200 |
| GRAND TOTAL | 1,223,300 | 369,800 | 1,593,100 | 1,102,900 | 179,000 | 1,281,900 | 120,400 | 190,800 | 311,200 |

a/ Price base 1974.

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TABLE 2B - RECREATIONAL FACILITIES ESTIMATED CONSTRUCTION COSTS

Wet Walnut Creek Subwatershed No. 1, Kansas

(Dollars)a/

Multipurpose Structure No. 1

| Item | Number | Estimated Unit Cost | Total Construction Cost |
|---|---|---|---|
| Road, gravel, 24' | 2,900 lin. ft. | $1.85/lin. ft. | $ 5,400 |
| Parking Areas, gravel (2) | 20,000 sq. ft. | $.075/sq. ft. | 1,500 |
| Fence, barbed, 4 wire, Steel posts | 4.2 mi. | $3,000/mi. | 12,600 |
| Corrugated metal pipe, 24" | 108 ft. | $14/ft. | 1,500 |
| 100' Boat Ramp, concrete 14' wide | 1 ea. | Lump Sum | 2,500 |
| Vault toilet, concrete block | 2 ea. | Lump Sum | 5,000 |
| Drinking water well | 1 ea. | Lump Sum | 3,000 |
| Sun shades, wood | 4 ea. | $540 | 2,200 |
| Picnic tables, 7', wood | 8 ea. | $ 70 | 600 |
| Grill, metal (Waist-high) | 8 ea. | $ 50 | 400 |
| Refuse barrels, metal | 4 ea. | $ 20 | 100 |
| Contingencies | | | 7,000 |
| Total | | | $41,800 |

a/ Price base 1974.

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TABLE 2B - CONTINUED

Multipurpose Structure No. 4

| Item | Number | Estimated Unit Cost | Total Construction Cost |
|---|---|---|---|
| Road, gravel, 24' | 2,050 lin. ft. | $1.85/lin/ ft. | $ 3,800 |
| Parking Areas, gravel (2) | 24,000 sq. ft. | $.075/sq. ft. | 1,800 |
| Fence, barbed, 4 wire Steel posts | 5.3 mi. | $3,000/mi. | 15,900 |
| Corrugated metal pipe, 24" | 108 ft. | $14/ft. | 1,500 |
| 100' Boat Ramp, concrete 14' wide | 1 ea. | Lump Sum | 2,500 |
| Vault toilet, concrete block | 1 ea. | Lump Sum | 2,500 |
| Drinking water well | 1 ea. | Lump Sum | 3,000 |
| Sun shades, wood | 4 ea. | $540 | 2,200 |
| Picnic Tables, 7', wood | 8 ea. | $ 70 | 600 |
| Grill, metal (Waist high) | 8 ea. | $ 50 | 400 |
| Refuse barrels, metal | 4 ea. | $ 20 | 100 |
| Contingencies | | | 6,900 |
| Total | | | $41,200 |

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TABLE 3 - STRUCTURE DATA
MULTIPURPOSE AND FLOODWATER RETARDING STRUCTURES

Wet Walnut Creek Subwatershed No. 1, Kansas

| ITEM | UNIT | STRUCTURE NO. 1 MP | 2 | 3 | 4 MP | 5 | 6 | 7 | 8 | 9 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Class of Structure | | b | a | a | b | b | b | b | b | a | |
| Drainage Area | Sq. Mi. | 13.40 | 6.21 | 2.72 | 12.34 | 1.71 | 4.88 | 4.82 | 2.69 | 3.18 | 51.95 |
| Controlled | Sq. Mi. | -- | -- | -- | -- | -- | -- | -- | -- | -- | |
| Curve No. (1-day) (AMC II) | | 75 | 74 | 75 | 74 | 74 | 74 | 74 | 75 | 75 | |
| TC | Hours | 3.6 | 2.5 | 1.6 | 4.25 | 1.3 | 3.1 | 2.1 | 1.3 | 1.3 | |
| Elevation Top of Dam | Feet | 1,995.1 | 1,970.1 | 2,004.8 | 1,983.0 | 2,050.0 | 2,058.2 | 2,061.0 | 2,142.5 | 2,051.0 | |
| Elevation Crest Emergency Spillway | Feet | 1,989.6 | 1,964.8 | 1,999.8 | 1,978.0 | 2,045.0 | 2,051.8 | 2,055.9 | 2,137.5 | 2,046.0 | |
| Elevation Crest Low Stage Inlet | Feet | 1,976.0 | 1,952.5 | 1,989.3 | 1,967.2 | 2,035.0 | 2,040.3 | 2,047.3 | 2,129.2 | 2,032.5 | |
| Maximum Height of Dam | Feet | 47.6 | 23.3 | 21.0 | 33.3 | 22.5 | 26.7 | 24.1 | 19.7 | 36.0 | |
| Volume of Fill | Cu. Yds. | 198,500 | 96,000 | 45,700 | 192,500 | 54,500 | 97,800 | 110,700 | 55,000 | 74,700 | 925,400 |
| Total Capacity | Ac. Ft. | 2,751 | 1,146 | 489 | 2,439 | 367 | 942 | 954 | 575 | 587 | 10,250 |
| Sediment Submerged | Ac. Ft. | 229 | 109 | 53 | 244 | 38 | 94 | 116 | 65 | 76 | 1,024 |
| Sediment Aerated | Ac. Ft. | -- | 4 | 1 | -- | 1 | 2 | 2 | 1 | 2 | 13 |
| Beneficial Use (Recreation) | Ac. Ft. | 321 | -- | -- | 221 | -- | -- | -- | -- | -- | 542 |
| Retarding | Ac. Ft. | 2,201 | 1,033 | 435 | 1,974 | 328 | 846 | 836 | 509 | 509 | 8,671 |
| Surface Area | | | | | | | | | | | |
| Sediment Pool | Acres | 35 | 33 | 17 | 65 | 12 | 25 | 39 | 24 | 14 | 264 |
| Beneficial Use Pool (Recreation) | Acres | 80 | -- | -- | 102 | -- | -- | -- | -- | -- | 182 |
| Retarding Pool | Acres | 260 | 154 | 72 | 278 | 65 | 135 | 174 | 108 | 70 | 1,316 |
| Principal Spillway | | | | | | | | | | | |
| Rainfall Volume (areal) (1-day) | Inches | 6.5 | 6.6 | 5.9 | 6.4 | 6.5 | 6.5 | 6.5 | 6.4 | 5.9 | |
| Rainfall Volume (areal) (10-day) | Inches | 10.1 | 10.2 | 9.3 | 10.1 | 10.1 | 10.0 | 10.0 | 10.0 | 9.3 | |
| Runoff Volume (10-day) | Inches | 4.02 | 4.14 | 3.84 | 3.90 | 4.44 | 4.10 | 4.10 | 4.31 | 3.80 | |
| Capacity of Low Stage (Max.) | c.f.s. | 69.1 | 26.2 | 12.7 | 59.2 | 9.9 | 27.2 | 26.9 | 11.8 | 15.8 | |
| Frequency Operation - Emerg. Splwy. | % Chance | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | |
| Size of Conduit | Dim. | 24" | 18" | 18" | 24" | 24" | 24" | 24" | 24" | 18" | |
| Emergency Spillway | | | | | | | | | | | |
| Rainfall Volume (ESH) (areal) | Inches | 7.4 | 7.6 | 5.0 | 7.5 | 7.6 | 7.6 | 7.6 | 7.6 | 5.0 | |
| Runoff Volume (ESH) | Inches | 4.47 | 4.57 | 2.45 | 4.48 | 4.57 | 4.57 | 4.57 | 4.68 | 2.45 | |
| Type | | Veg. | Veg. | Veg. | Veg. | Veg. | Veg. | Veg. | Veg. | Veg. | |
| Bottom Width | Feet | 760 | 300 | 60 | 500 | 80 | 100 | 100 | 80 | 80 | |
| Velocity of Flow ($V_e$)[a/] | Ft./Sec. | 4.5 | 5.4 | [b/] | 5.3 | 4.7 | 5.8 | 4.9 | 6.3 | [b/] | |
| Slope of Exit Channel | Ft./Ft. | .039 | .035 | [b/] | .036 | .038 | .033 | .037 | .035 | [b/] | |
| Maximum Water Surface Elevation | Feet | 1,991.8 | 1,966.9 | [b/] | 1,979.9 | 2,046.5 | 2,054.0 | 2,057.3 | 2,139.3 | [b/] | |
| Freeboard | | | | | | | | | | | |
| Rainfall Volume (FH) (areal) | Inches | 13.2 | 13.6 | 7.6 | 13.3 | 13.6 | 13.6 | 13.6 | 13.6 | 7.6 | |
| Runoff Volume (FH) | Inches | 9.90 | 10.14 | 4.68 | 9.85 | 10.14 | 10.14 | 10.14 | 10.29 | 4.68 | |
| Maximum Water Surface Elevation | Feet | 1,995.1 | 1,970.1 | 2,002.5 | 1,982.7 | 2,048.9 | 2,058.2 | 2,061.0 | 2,142.1 | 2,049.0 | |
| Capacity Equivalents | | | | | | | | | | | |
| Sediment Volume | Inches | 0.32 | 0.34 | 0.37 | 0.37 | 0.43 | 0.37 | 0.46 | 0.46 | 0.46 | |
| Retarding Volume | Inches | 3.08 | 3.12 | 3.00 | 3.00 | 3.60 | 3.25 | 3.25 | 3.55 | 3.00 | |
| Other | Inches | 0.45 | -- | -- | 0.34 | -- | -- | -- | -- | -- | |

a/ Maximum during passage of hydrograph
b/ Emergency spillway hydrograph is contained below crest of emergency spillway

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TABLE 4 - ANNUAL COST

Wet Walnut Creek Subwatershed No. 1, Kansas

(Dollars)[a/]

| Evaluation Unit | Amortization of Installation Costs[b/] | Operation and Maintenance Costs[c/] | Total |
|---|---|---|---|
| 7 Floodwater Retarding Structures, 2 Multipurpose Structures, and Recreational Facilities | 97,800 | 26,800 | 124,600 |
| Project Administration | 28,400 | | 28,400 |
| GRAND TOTAL | 126,200 | 26,800 | 153,000 |

a/ Price base 1974
b/ 100 years at 6 1/8 percent interest
c/ Includes $23,200 for Operation-maintenance and replacement of recreational facilities

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Wet Walnut Creek Subwatershed No. 1, Kansas

(Dollars)a/

| Item | Estimated Average Annual Damage | | Total Damage Reduction Benefits |
|---|---|---|---|
| | Without Project | With Project | |
| Floodwater | | | |
| Crop and Pasture | 332,700 | 177,500 | 155,200 |
| Other Agricultural | 6,000 | 1,100 | 4,900 |
| Non-agricultural | | | |
| Road and Bridge | 15,400 | 6,400 | 9,000 |
| Railroad | 1,300 | 100 | 1,200 |
| Urban | 25,100 | 6,200 | 18,900 |
| Subtotal | 380,500 | 191,300 | 189,200 |
| Sediment | | | |
| Channel Deposition | 3,200 | 2,700 | 500 |
| Erosion | | | |
| Flood Plain Scour | 46,400 | 22,700 | 23,700 |
| Indirect | 44,800 | 24,400 | 20,400 |
| TOTAL ON PROJECT | 474,900 | 241,100 | 233,800 |
| Floodwater | | | |
| Crop and Pasture | xxx | xxx | 2,000 |
| Other Agricultural | xxx | xxx | 200 |
| Non-agricultural | | | |
| Road and Bridge | xxx | xxx | 500 |
| Railroad | xxx | xxx | 300 |
| Urban | xxx | xxx | 34,800 |
| TOTAL OFF PROJECT | | | 37,800 |
| TOTAL | | | 271,600 |

a/ Price base: Agricultural = current normalized (WRC - October 1974); all other = 1974

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Wet Walnut Creek Subwatershed No. 1, Kansas

(Dollars)a/

| Evaluation Unit | Average Annual Benefitsa/ | | | | Total | Average Annual Costc/ | Benefit Cost Ratio |
|---|---|---|---|---|---|---|---|
| | Damage Reductionb/ | More Intensive Land Use | Recreation | Secondary | | | |
| 7 Floodwater Retarding Structures and 2 Multi-purpose Floodwater Retarding and Recreational Structures | 58,700 | 9,700 | 140,000 | 30,300 | 238,700 | 124,600 | 1.9:1 |
| Project Administration | | | | | | 28,400 | |
| GRAND TOTAL | 58,700 | 9,700 | 140,000 | 30,300 | 238,700 | 153,000 | 1.6:1 |

a/ Price base: Agricultural current normalized (WRC - October 1974); all other 1974

b/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $62,600 annually including $30,200 from detention structures; P.L. 566 structures in upper watersheds will provide $150,300 damage reduction.

c/ From Table 4

December 1975

## INVESTIGATIONS AND ANALYSIS

### General

A joint study of the Upper Arkansas Basin by the Soil Conservation Service, Forest Service, Economic Research Service, and the Kansas Water Resources Board was started May 4, 1965. Wet Walnut Creek was studied as an example of large watershed potential in western Kansas. Stream and valley cross sections were surveyed by the Kansas Water Resources Board in five mainstem reaches from Heizer to Ness City and on three reaches of the North and South Forks above Ness City. Hydraulic computations were made by Cook, Flatt and Strobel, Consulting Engineers, Topeka, Kansas.

The Kansas Watershed Review Committee assigned a priority for planning on July 31, 1967. A groundwater recharge study was started for the Wet Walnut Basin as a cooperative venture of the Kansas Water Resources Board, the U.S. Geological Survey, and the Wet Walnut Creek Watershed District during the summer of 1968. The State Conservation Commission negotiated and funded contracts for structure site topographic maps of the Public Law 566 sites. Structures in the eastern half of the watershed district were surveyed by Evans, Bierly, and Hutchison, Consulting Engineers, Great Bend, Kansas; and structures in the western half of the watershed district were surveyed by George McKee, Jr., Consulting Engineer of Colby, Kansas. All other engineering, geologic, hydrologic, and economic investigations were conducted by the Soil Conservation Service.

A forestry work plan was developed by the State Extension Forester, Kansas State University, Manhattan, Kansas, and the Forest Service, U.S.D.A. Information for this plan was gathered from aerial photography of the watershed and a field examination of hydrologic conditions of woodlands. Estimates were made of land treatment measures needed to improve hydrologic conditions; these estimates were included in this work plan.

A letter report 13/ covering fish and wildlife resources and recommending measures to offset losses and enhance wildlife habitat was supplied by the Fish and Wildlife Service, U.S. Department of the Interior. The Kansas Forestry, Fish and Game Commission concurred with this report.

The Kansas Water Resources Board and State Conservation Commission provided assistance in drafting the watershed plan and environmental impact statement.

Hydrology and Hydraulics

The five Wet Walnut watersheds were treated as a hydrologic unit, and broken down into 21 reaches. Each reach was evaluated for its present soil cover condition and for its future condition with planned land treatment and cover measures.

A standard procedure22/ was used to find the relationship between rainfall and runoff with special consideration given to flat potholed areas and areas treated with level storage type terraces. A factor of 2.3 was used to convert the annual flood plotting positions to partial duration plotting positions. The relationship between rainfall frequency and runoff volume was calculated for the actual range of hydrologic curve numbers.

Field surveys of the valley and road and bridge cross sections were made. Sufficient readings were taken to define the topography along each section, to locate all crop boundaries and changes in roughness, to locate all roads, fences, and other objects along the sections, and to define the shape of the channel in detail. The types of road surfaces and bridges were indicated on each road cross section.

The step method was used in defining the hydraulics of the flood plain. A range of discharges from below non-damage flow to above 100 year flood frequency was considered. Flood plain profiles were plotted showing the channel bottom, bank line, and at least five discharges. A semi-controlled, screened aerial mosaic map of the flood plain was developed for each reach.

The relationship between discharge and area of flood plain inundation was based on 73 valley and channel cross sections in eight detailed evaluation reaches. These cross sections were vertically related to mean seal level, and horizontally related by using aerial photographs. The width of flooding at each cross section and the distance between cross sections were used to compute the area flooded in each reach by depth increments. These area data were then combined to determine totals for each evaluated reach.

Similarly, road and bridge cross sections were used to compute lengths of roads inundated by various flood depths.

Frequency discharge relationships were developed for each reach using the SCS TR-20 computer program with service provided by the Central Technical Unit, Hyattsville, Maryland. Four uniform storms were routed to define discharge frequency curves for present conditions, future conditions with land treatment, future conditions with land treatment and various percentages of control by structures, and future conditions with land treatment and the proposed system of structures. These routings gave the discharge frequency relationship for each evaluation reach under present conditions and for various levels of control including that offered by the proposed plan. Routings were developed for historical storms, September 1959 and May-June 1967, and high-water marks were plotted on water surface profiles and peaks determined.

Release rates for structures were selected according to downstream channel capacities, routing losses, and desired reservoir drawdown times. Single stage release rates for all structures are shown in Table 3, page 64 (see "Capacity of Low Stage (Max.)"). Combined maximum release rates will not exceed channel capacities.

Floodwater storage volumes were determined using mass routing procedures for storm durations of up to 10 days. Storms used in this procedure were taken from U.S. Weather Bureau Technical Paper No. 40.23/ The volumes needed for floodwater storage were computed using 25, 50, or 100 year frequency storms, depending on the structure hazard class. Floodwater storages were selected to fit site conditions, with minimum volumes computed in accordance with the National Engineering Handbook.

Emergency spillway requirements were found by routing the storms according to SCS, Engineering Memorandum No. 27. Computer services were provided by SCS at Lincoln, Nebraska, and Fort Worth, Texas. Emergency spillways will exceed minimum criteria set by the State of Kansas.

For the design of the two recreation sites, trial and error solutions of the water budget equation by computer program, using average values over each drought period, gave the expected reservoir level-frequency relationship. Yields used were minimum cfs per square mile for a range of time periods and drought frequency.24/ Net evaporation values 25/ were also included in the computations. Evaporation and

seepage losses were applied against the average reservoir surface area for each period under consideration. Mean annual runoff at each of the two sites was also computed by relating to channel geometry with assistance from the U.S. Geological Survey. 35/

Engineering

Topographic maps of the sites for floodwater retarding structures and multipurpose structures were made using a photogrammetric plotter and field surveys. Aerial photographs were taken from approximately 4,800 feet, and topographic maps were made using a four foot contour interval. Accuracy of plotter work was verified by field surveys of centerline profiles. Using the topographic maps, storage capacities were measured and stage-storage curves were developed. Embankment quantities were calculated from centerline profiles.

An inventory of all man-made features, such as farm buildings, roads, bridges, existing and abandoned oil wells, pipelines, power lines, etc., was made and those affected by structures were located on the topographic maps.

Structure Design and Cost Estimates: Structures were planned with single-stage principal spillways and average release rates of 3.5 csm. Elevations of emergency spillway crests were selected to provide at least a 25 year detention storage.

Storage will be provided for a 100 year accumulation of sediment. The elevations of principal spillway crests of floodwater retarding structures will be at the 100 year sediment accumulation levels. The inlets of multipurpose structures are planned at the elevation that will store the 100 year sediment accumulations and provide water for recreation.

The freeboard hydrograph was routed through all structures with the maximum elevations at or below the tops of the dams

Drainage areas for all sites were delineated and measured on USGS 7 1/2 minute quadrangle maps and photographs.

Individual structure cost data are presented in Table 2, and the total cost of all proposed structures is shown in Table 1.

Unit costs, reflecting current bid prices for embankment, principal spillways, riprap, fencing, drains, seeding, clearing, etc., were used to determine the total construction cost of each structure. Contingencies were calculated at 12 percent of the engineer's estimate. Installation services' costs were calculated as a percentage of construction cost.

Geology

Structure Nos. 1 and 4 were among 10 sites in Watershed Nos. 1 through 5 selected by the Kansas Forestry, Fish and Game Commission in 1970 as having a potential for development as fishing lakes. The SCS analyzed the water-holding characteristics of these sites. Infiltration tests were run at all sites. Field determinations of seepage losses at constructed sites in Cimarron Watershed were made and compared with the infiltration tests. It was determined that 395 acre feet of pore space at Structure No. 1 and 300 acre feet of pore space at Structure No. 4 would have to be filled prior to establishment of permanent pools. It was concluded from analysis of infiltration tests and knowledge of available pore space that a permanent water mound would be established at both sites by the second year of operation and that future seepage losses to maintain the mounds would be minimal.

A groundwater study was conducted by the SCS from May 25 to July 15, 1967. The results of this study were incorporated into a more intensive study by the USGS for Rush County and summarized in Bulletin No. 17 (1972) of the Kansas Water Resources Board.19/

The preceding two studies were used by SCS to make an algebraic account of the present without and future with project average annual water budget for the Wet Walnut Basin. The water budget included an accounting of recharge waters available for withdrawal, evapotranspiration losses, return flows, and reductions in discharge. The basin water budget was compiled by subwatersheds.

The Greenhorn Limestone underlies the nine proposed floodwater retarding structures. The foundation is chalky shale alternating with beds of hard chalk. All nine sites were surface inspected. Site Nos. 1 and 4 were drilled. Surface and drilling investigations revealed favorable construction conditions.

Sediment storage was based on existing reservoir sedimentation surveys. A delivery ratio of 7 percent was used for

determining sediment yield from Watershed No. 1 to the Arkansas River.

Economic Investigations

Seven reaches representing 57 percent of the flood plain were evaluated in detail. The additional area was evaluated as related to these reaches. Five subwatersheds were evaluated as a unit then divided into individual reaches. Twelve of the 21 reaches had significant flood damages.

The frequency method 26/ was used to find average annual floodwater damages. Data on floodwater damages were collected by personal contacts with farm operators, township and county officials, and local agricultural technicians. Interviews were obtained from at least 46 percent of the landowners and operators of the flood plain area in each evaluation reach; the maximum interview coverage in any one reach was 65 percent. The storms of Spetember 1959 and July 1958 were discussed.

Damages that occurred under present land treatment conditions were computed in each evaluation reach. Damage estimates were made for future land treatment conditions, future land treatment conditions with varying percentages of control by floodwater retarding structures, and future land treatment conditions with the proposed plan. Where more intensive use of land would be possible, benefits were computed under these same conditions. More intensive use was computed on those acres lying within the flood plain delineated by 2.84 year and the 10 year frequency floods.

A composite acre of flood plain use was constructed by measuring the percent of each land use shown on valley cross sections. Average crop yields, adjusted to flood-free conditions by the judgment of farm operators and agricultural technicians, were projected to reflect future conditions without the project. Different composite acres and crop yields, which would be possible under more intensive land use, were similarly obtained.

The percent loss from each crop on the composite acre was estimated according to depth, duration, and month of flooding. The damage to the composite acre was weighted using the lower values of crop yields from the scoured areas. The percent loss was used to determine rates of damage on the composite acre (adjusted normalized prices), using the percent of the year's excessive storms occurring in each month,27/ and the

weighted value of the composite acre multiplied by total acreage inundated by selected discharges. A curve showing monetary damage versus flood discharge was developed to provide a cost estimate for each storm in the 100 year flood series. A weighted value (current normalized value) was developed and damages updated by a factor.

Interviews were used to determine other agricultural damages from the September 1959 and July 1958 storms. These included loss of livestock, damage to private roads, dikes, and fences, and removal of debris. From rainfall records and high-water marks, the discharge of these storms was determined for each evaluation reach. From these data a dollar damage versus discharge curve was developed and applied to the 100 year flood frequency series. These values were updated to current prices.

Road and bridge damages were based on repair or replacement costs obtained from county engineers. Damages to various types of road surfaces were computed as the dollar damage per foot by depth of inundation. Damages to individual bridges were estimated for a range of discharges. Road and bridge damages were then combined in each evaluation reach and dollar damage versus discharge curves were plotted. These curves were then applied to the 100 year flood frequency series. The values were updated using the Engineering News Record Construction Cost Index.

Flood plain scour damages were derived from geologic field data. The number of acres damaged, the severity of damage, and the estimated period and degree of recovery were considered, with and without the proposed project. The economic evaluation was based on the net value of the cropland composite acre. The changes in net income due to scour damage were discounted at an eight percent interest rate.

Urban damages were determined by interviews with owners or occupants of all businesses and homes in the towns. The 1959 and 1958 storms were discussed. The percent chance of occurrence was determined for each of these storms, and a curve drawn to compute the average annual damage. This value was updated to 1974 based on the composite index (U.S. Department of Commerce).

Indirect damages include such items as food spoilage from electric power failure; slower rate of weight gain of livestock and extra expense caused by feeding interruption (even

though livestock were not in the flood); and additional distances driven by rural mail carriers; school buses, and farmers because of flooded roads. Indirect damages were computed at 10 percent of the agricultural damages and 15 percent of the nonagricultural damages.

Recharge benefits were computed as the increased net value from dry land cropland to irrigated cropland for that number of acres for which water will become available. This value was reduced for increased floodwater damage and discounted for a 10 year lag in accrual.

The damage reduction benefits occurring downstream from Subwatershed No. 1 are fair share benefits accruing to the project from the Great Bend area. This included 13,100 acres of Wet Walnut flood plain below the watershed and 2,200 acres of flood plain common with the Arkansas River.

Increased flood damages from reduced channel capacity from sediment deposits were computed.

Recreation benefits were determined using procedures outlined in the Economic Guide 26/ the Lincoln EWP Technical Letter Recreation No. 5 (April 5, 1965), and Lincoln EWP Technical Letter Recreation No. 6 (April 5, 1966). The watershed was computed to have a population of 5,914 people.

Within a 50 mile radius of the watershed there is a population of more than 128,100 people. Consultation with the staff of the Kansas Forestry, Fish and Game Commission and the Kansas Park and Resources Authority indicated that the demand for water-based recreation, such as that which would be offered at Site Nos. 1 and 4 would exceed 70,000 annual visitor days.

It was estimated that 60 percent of the total use would occur from May 15 to September 15 and that 65 percent of the visits would occur on a weekend day. By limiting parking area, recreational facilities were designed to limit use to 720 visits per weekend day. Additional parking space is provided to accommodate vehicles on unmarked gravel parking lots. Other facilities were designed to adequately provide for visitor needs. A current value of $2.00 per each visit was used.

Incidental recreation benefits were not evaluated. Regional secondary benefits were computed following procedures in the EWP Technical Note--Watershed LI-7, February, 1973.

Indirect benefits and benefits resulting from a change in consumptive patterns were excluded from consideration in computing secondary benefits. The region is defined as five counties, Barton, Rush, Ness, Lane, and Scott.

All structures were individually evaluated. The relative contribution that structural control in each upstream sub-watershed made toward reduction of peak discharge was the basis for distribution of evaluation reach benefits.

Costs of land rights were based on the value of cropland and pasture as determined by the watershed directors. These values, slightly higher than the capitalized value of net production, were used for project evaluation. These values agreed on were $300/acre for upland cropland, $750/acre for botton cropland, and $200/acre for pasture for the floodwater retarding sites. Land costs were based on 100 percent of value for the sediment pool areas, 75 percent of value for the structure and spillway areas, and 50 percent of value for the floodwater retarding areas. The productive capacity retained under future conditions was thereby considered. Full fair market value was used as the basis for the cost of all land purchased for the recreation development.

All monetary benefits were based on current normalized prices approved by the Water Resources Council. Construction costs were based on 1974 construction costs for Kansas P.L. 566 projects. Operation and maintenance costs were computed at 0.35 percent of construction costs for floodwater retarding structures; this percentage method was developed by the SCS and is based on the principle that the relative probability of need for major repairs decreases as the number of structures increases. Operation and maintenance costs for the recreational facilities were computed at the current cost of $0.30 per visitor day. Replacement costs of these facilities were computed on the basis of a 20 year life. Federal and local costs for structural measures were amortized at 6 1/8 percent interest rate for a period of 100 years.

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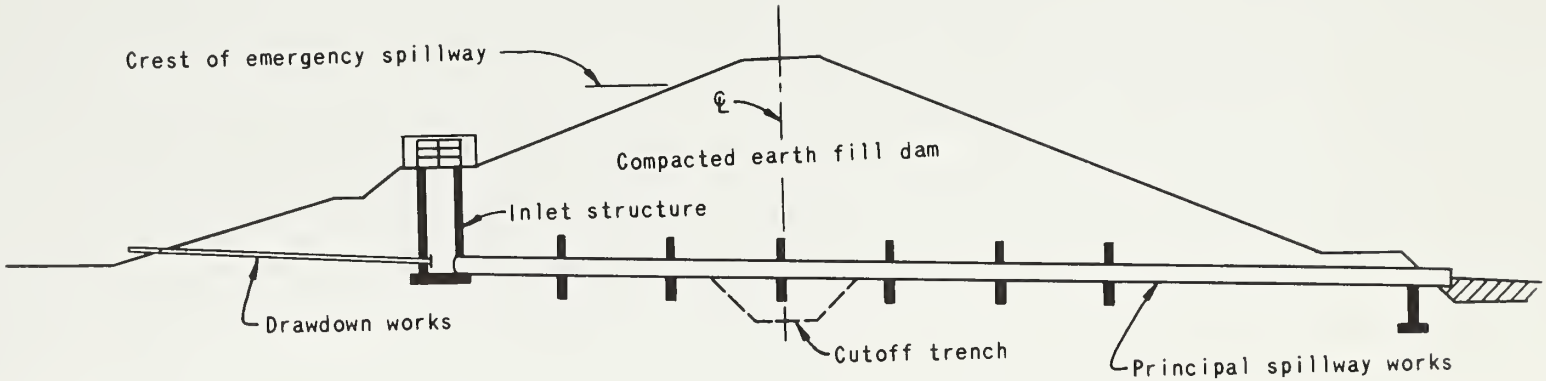
# TYPICAL EARTH DAM WITH PIPE DROP INLET

FIGURE 1




## CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY

NOTES:

1. FOR INDIVIDUAL STRUCTURE DATA SEE TABLE 3.
2. EMBANKMENT AND FOUNDATION DESIGN FEATURES NOT SHOWN.

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

# WET WALNUT CREEK WATERSHED NO. 1

BARTON AND RUSH COUNTIES, KANSAS

STRUCTURE NO. 1

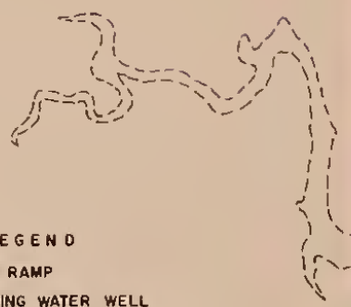
PUBLIC RECREATION DEVELOPMENT.

SCALE 300 0 300 600 900 FEET
150

N


POPULATION CENTERS AND HIGHWAYS
WITHIN 50 MILE RADIUS

SCALE 10 5 0 10 20 30 40 MILES




LEGEND

① BOAT RAMP
② DRINKING WATER WELL
③ PARKING AREA & ROAD
④ PICNIC TABLE
⑤ PICNIC TABLE WITH SUNSHADE
⑥ TOILET

KANSAS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

# WET WALNUT CREEK WATERSHED NO.1

BARTON AND RUSH COUNTIES, KANSAS

STRUCTURE NO. 4

PUBLIC RECREATION DEVELOPMENT

SCALE 300 0 300 600 900 FEET
150

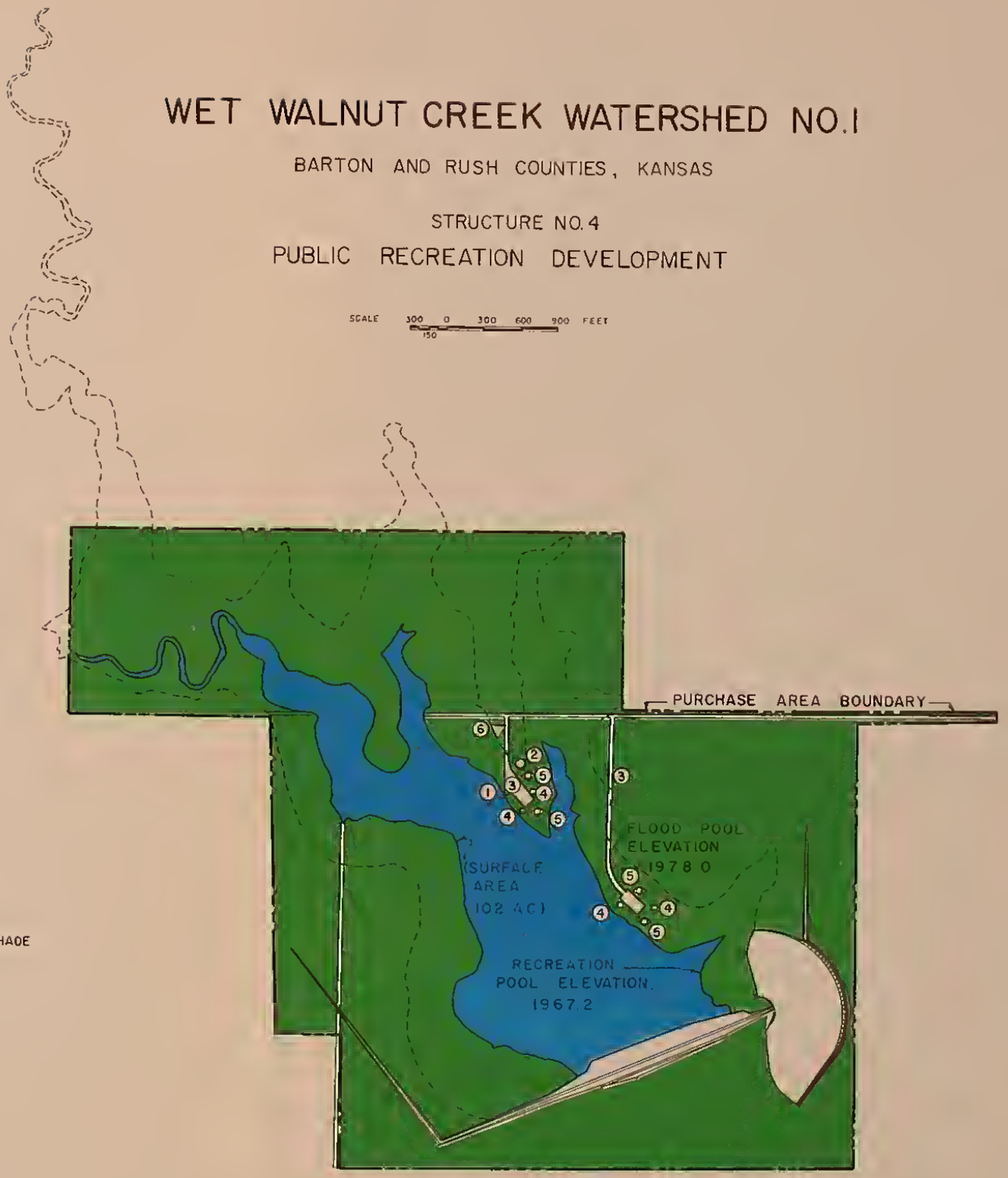

POPULATION CENTERS AND HIGHWAYS
WITHIN 50 MILE RADIUS

SCALE 10 5 0 10 20 30 40 MILES

LEGEND

1. BOAT RAMP
2. DRINKING WATER WELL
3. PARKING AREA & ROAD
4. PICNIC TABLE
5. PICNIC TABLE WITH SUNSHADE
6. TOILET

KANSAS



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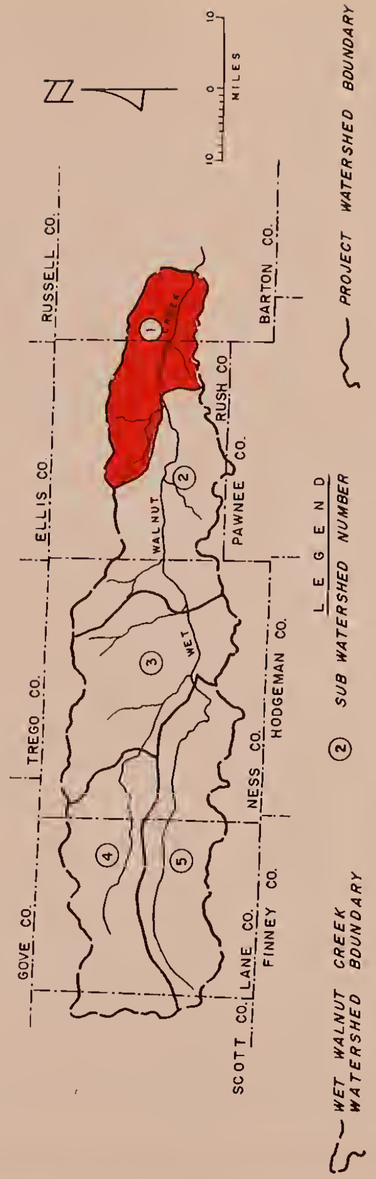
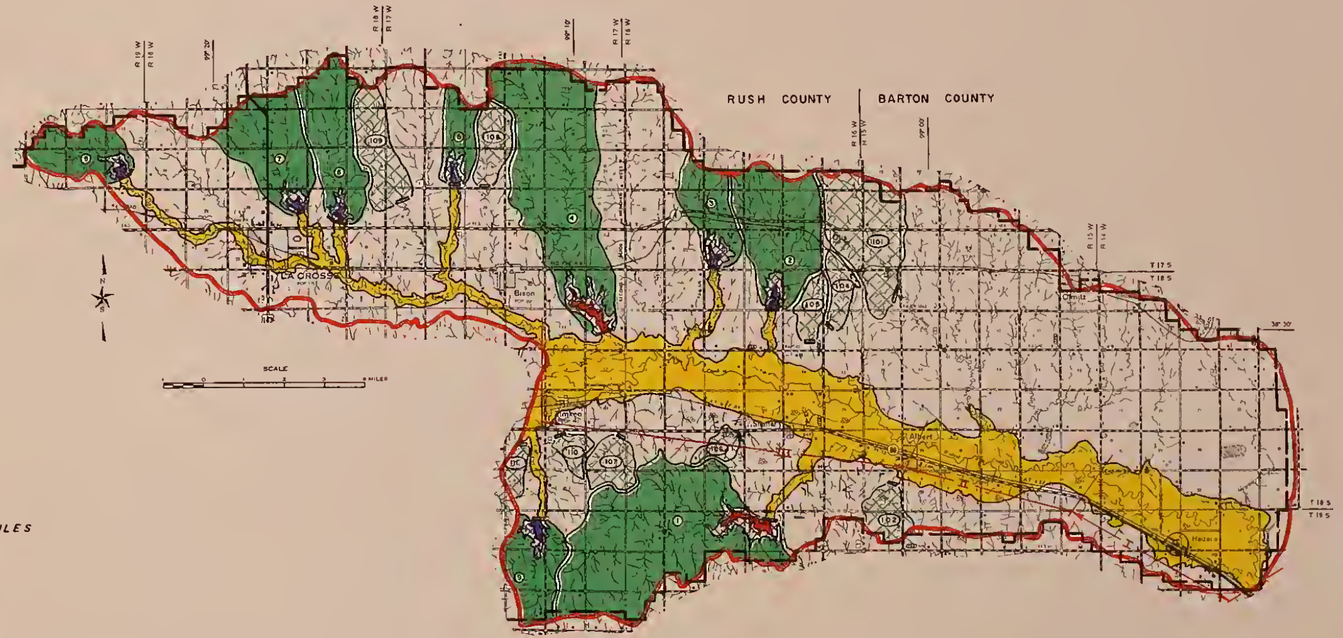
SOIL CONSERVATION SERVICE

# PROJECT MAP
# SUBWATERSHED NO. (1) WET WALNUT CREEK WATERSHED
BARTON AND RUSH COUNTIES
KANSAS

KANSAS

## WATERSHED PROJECTS LOCATION
## WET WALNUT CREEK



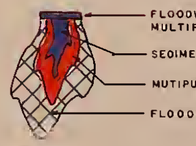




DRAINAGE AREA IN SQUARE MILES

| | | | |
|---|---|---|---|
| (1) | 13.40 | (101) | 5.90 |
| (2) | 6.21 | (102) | 1.30 |
| (3) | 2.72 | | |
| (4) | 12.34 | (104) | 1.10 |
| (5) | 1.71 | (105) | 0.90 |
| (6) | 4.88 | (106) | 0.69 |
| (7) | 4.82 | (107) | 1.30 |
| (8) | 2.69 | (108) | 1.38 |
| (9) | 3.18 | (109) | 3.02 |
| | | (110) | 0.50 |
| | | (111) | 0.58 |

LEGEND

- LEGAL WATERSHED BOUNDARY
- NATURAL WATERSHED BOUNDARY
- DRAINAGE AREA CONTROLLED BY P.L. 566 STRUCTURE
- EVALUATION REACH



- FLOODWATER RETARDING OR MULTIPLE PURPOSE STRUCTURE
- SEDIMENT STORAGE POOL
- MUTIPURPOSE STORAGE POOL
- FLOODWATER DETENTION POOL

- AREA BENEFITED
- DRAINAGE AREA CONTROLLED BY R.E.A.P. STRUCTURE
- (2) P.L. 566 STRUCTURE NUMBER
- (202) R.E.A.P. STRUCTURE NUMBER

SOURCE:
INFORMATION FURNISHED BY FIELD TECHNICIANS, EVANS - BIERLY - HUTCHISON ENGINEERS